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United States Environmental Protection Agency
http://www.epa.gov/air/tribal/tribalnsr.html

Part 2: Submit Within 60 Days After Startup of Production -- Emission and Production Information

FEDERAL IMPLEMENTATION PLAN FOR TRUE MINOR SOURCES IN INDIAN COUNTRY IN THE OIL AND NATURAL GAS PRODUCTION AND NATURAL GAS PROCESSING SEGMENTS OF THE OIL AND NATURAL GAS SECTOR

Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources

Please submit information to:

[Reviewing Authority
Address
Phone]

A. GENERAL SOURCE INFORMATION (See Instructions Below)

1. Company Name BP America Production Company		**2. Source Name** Tiffany 2 Well Pad	
3. Type of Oil and Natural Gas Operation Oil and gas well pad		**4. New Minor Source?** ☒ Yes ☐ No **5. True Source Modification?** ☐ Yes ☒ No	
6. NAICS Code 211111		**7. SIC Code** 1311	
8. U.S. Well ID(s) or API Number(s) [if applicable] See Attachments			
9. Area of Indian Country Southern Ute Indian Reservation	**10. County** La Plata	**11a. Latitude** See Attachments	**11b. Longitude** See Attachments

B. CONTACT INFORMATION (See Instructions Below)

1. Owner Name BP America Production Company	Title
Mailing Address	380 Airport Road, Durango, CO 81303
Email Address	john.ritchie@bp.com
Telephone Number (505) 608-3698	Facsimile Number (970) 247-6880
2. Operator Name (if different from owner)	Title
Mailing Address	
Email Address	
Telephone Number	Facsimile Number
3. Source Contact John Ritchie, Field Environmental Coordinator	Title
Mailing Address	380 Airport Road, Durango, CO 81303
Email Address	john.ritchie@bp.com
Telephone Number (505) 608-3698	Facsimile Number (970) 247-6880

4. Compliance Contact John Ritchie, Field Environmental Coordinator	Title
Mailing Address	380 Airport Road, Durango, CO 81303
Email Address	john.ritchie@bp.com
Telephone Number (505) 608-3698	Facsimile Number (970) 247-6880

C. EMISSIONS AND OTHER SOURCE INFORMATION

Include all of the following information in the table below and as attachments to this form:

Note: The emission estimates can be based upon actual test data or, in the absence of such data, upon procedures acceptable to the Reviewing Authority. The following procedures are generally acceptable for estimating emissions from air pollution sources: (1) unit-specific emission tests; (2) mass balance calculations; (3) published, verifiable emission factors that are applicable to the unit (i.e., manufacturer specifications); (4) other engineering calculations; or (5) other procedures to estimate emissions specifically approved by the Reviewing Authority. Guidance for estimating emissions can be found at http://www.epa.gov/ttn/chief/efpac/index.html.

- ■ Narrative description of the operations.
- ■ Identification and description of any air pollution control equipment and compliance monitoring devices or activities.
- ■ Type and actual amount (annually) of each fuel that will be used.
- ■ Type of raw materials used (e.g., water for hydraulic fracturing).
- ■ Actual, annual production rates.
- ■ Actual operating schedules.
- ■ Any existing limitations on source operations affecting emissions or any work practice standards, where applicable, for all regulated New Source Review (NSR) pollutants at your source. Indicate all requirements referenced in the Federal Implementation Plan (FIP) for True Minor Sources in Indian Country in the Oil and Natural Gas Production and Natural Gas Processing Segments of the Oil and Natural Gas Sector that apply to emissions units and air pollution generating activities at the source or proposed. Include statements indicating each emissions unit that is an emissions unit potentially subject to the requirements referenced in the FIP, but does not meet the definition of an affected facility under the referenced requirement, and therefore, is not subject to those requirements.
- ■ For each emissions unit comprising the new source or modification, estimates of the total allowable (potential to emit) annual emissions at startup of production from the air pollution source for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides ( ), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Allowable annual emissions are defined as: emissions rate of an emissions unit calculated using the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical

or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation, or the effect it would have on emissions, is legally and practically enforceable. You must determine the potential for emissions within 30 days from the startup of production.

☒ For each emissions unit comprising the new source or modification, estimates of the total actual annual emissions during the upcoming, consecutive 12 months from the air pollution source for the following air pollutants: particulate matter (PM, PM_{10}, $PM_{2.5}$), sulfur oxides (SO_x), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, ammonia (NH_3), fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Estimates of actual emissions must take into account equipment, operating conditions, and air pollution control measures. You should calculate an estimate of the actual annual emissions using estimated operating hours, production rates, in-place control equipment, and types of materials processed, stored, or combusted.

D. TABLE OF ESTIMATED EMISSIONS

Provide in the table below estimates of the total allowable annual emissions in tons per year (tpy) and total actual annual emissions (tpy) for the following pollutants for all emissions units comprising the new source or modification.

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
PM	0.4508	0.4508
PM_{10}	0.0744	0.0744
$PM_{2.5}$	0.0744	0.0744
SO_x	0.0236	0.0236
NO_x	19.1904	19.1904
CO	56.4898	56.4898
VOC	25.1237	25.1237
Pb		

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
NH3		
Fluorides		
H_2SO_4		
H_2S		
TRS		

Instructions for Part 2

Please answer all questions. If the item does not apply to the source and its operations write "n/a". If the answer is not known write "unknown".

A. General Source Information

1. Company Name: Provide the complete company name. For corporations, include divisions or subsidiary name, if any.
2. Source Name: Provide the source name. Please note that a source is a site, place, or location that may contain one or more air pollution emitting units.
3. Type of Operation: Indicate the generally accepted name for the oil and natural gas production or natural gas processing segment operation (e.g., oil and gas well site, tank battery, compressor station, natural gas processing plant).
4. New True Minor Source: [Per Federal Indian Country Minor New Source Review Rule, 40 CFR 49.153].
5. True Minor Source Modification: [Per Federal Indian Country Minor New Source Review Rule, 40 CFR 49.153].
6. North American Industry Classification System (NAICS): The NAICS Code for your oil and natural gas source can be found at the following link for North American Industry Classification System: http://www.census.gov/eos/www/naics/.
7. Standard Industrial Classification Code (SIC Code): Although the new NAICS code has replaced the SIC codes, much of the Clean Air Act permitting processes continue to use these codes. The SIC Code for your oil and natural gas source can be found at the following link for Standard Industrial Classification Codes: http://www.osha.gov/pls/imis/sic_manual.html.
8. U.S. Well ID or API Number: Unique well identifier as assigned by the Federal or State oil and gas regulatory agency with primacy, using the American Petroleum Institute (API) Standard for number format (pre-2014) or the Professional Petroleum Data Management (PPDM) Association US Well Number Standard (2014-present). Provide IDs for all oil and natural gas production wells associated with the facility, if applicable. May not be applicable for downstream production sources, such as compressor stations.
9. Area of Indian Country: Provide the name of the Indian reservation within which the source is operating.
10. County: Provide the County within which the source is operating.
11. Latitude & Longitude (11a. and 11b.): Provide latitude and longitude location(s) in decimal degrees, indicating the datum used in parentheses. These are GPS (global positioning system) coordinates. This information should be provided in decimal degrees with 6 digits to the right of the decimal point, indicating the datum used in parentheses (i.e., NAD 27, NAD 83, WGS 84 – WGS 84 is preferred over NAD 27).

B. Contact Information

Please provide the information requested in full.

1. Owners: List the full name (last, middle initial, first) of all owners of the source.
2. Operator: Provide the name of the operator of the source if it is different from the owner(s).
3. Source Contact: The source contact must be the local contact authorized to receive requests for data and information.
4. Compliance Contact: The compliance contact must be the local contact responsible for the source's compliance with this rule. If this is the same as the Source Contact please note this on the form.

C. Attachments

The information requested in the attachments will enable the U.S. Environmental Protection Agency (EPA) to understand the type of oil and natural gas source being registered and the nature and extent of the air pollutants to be emitted.

Disclaimers:

The public reporting and recordkeeping burden for this collection of information is estimated to average 6 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

Information in these forms submitted in compliance with the final Federal Indian Country Minor NSR rule may be claimed as confidential. A company may assert a claim of confidentiality for information submitted by clearly marking that information as confidential. Such information shall be treated in accordance with EPA's procedures for information claimed as confidential at 40 CFR part 2, subpart B, and will only be disclosed by the means set forth in the subpart. If no claim of confidentiality accompanies the report when it is received by EPA, it may be made public without further notice to the company (40 CFR 2.203).

C. ATTACHMENTS

As required by 40 CFR 49.160(c)(1)(iv) of the Federal Minor New Source Review Program in Indian Country, BP America Production Company (BP) is submitting the Part 2 Registration Form and associated attachments within sixty (60) days after the startup of production at the Tiffany 2 Well Pad, a new true minor oil and natural gas source complying with the Federal Implementation Plan (40 CFR 49.101 through 49.105). Startup of production occurred on December 14, 2017 with the first deliveries of the Tiffany 2-2 and Tiffany 2-3 wells. The site is located within the exterior boundaries of the Southern Ute Indian Reservation and is operated from BP's San Juan North Operations Center in Durango, Colorado. BP submitted the Part 1 Registration for the site on October 4, 2017.

Narrative description of the operations and identification and description of all emission units and air pollution generating activities:
The wellsites at the Tiffany 2 Well Pad produce natural gas. Since these are coal bed methane wells, the well streams are routed through fired separators to separate natural gas and produced water. The Tiffany 2-2 and 2-3 wells currently utilize artificial lift to optimize production and compression to move gas to a centralized facility for compression or processing. The compressed gas is sent through a tri-ethylene glycol dehydrator unit to remove entrained water prior to routing to a centralized facility.

Emission sources at the Tiffany 2 Well Pad currently include natural gas fired compressor, artificial lift, and generator engines, natural gas fired separator heaters, tri-ethylene glycol (TEG) dehydrator, natural gas fired glycol reboiler, chemical storage tanks, produced water storage tanks, and fugitive components. The engines constructed at the well pad are one (1) 1,035 nameplate-rated (994 site-rated) horsepower (hp) Caterpillar G3512B natural gas-fired compressor engine, one (1) 68 nameplate-rated (58 site-rated) hp Arrow VRG 330 natural gas-fired artificial lift engine, one (1) 68 nameplate-rated (58 site-rated) hp Waukesha VRG 330 natural gas-fired artificial lift engine, and one (1) PSI 5.7L NA natural gas-fired generator engine. Potential emissions from equipment at the site are less than the major source thresholds in 40 CFR 52.21 but equal to or greater than the thresholds for the Federal Minor New Source Review Program in Indian Country (40 CFR Part 49, Subpart C).

As required by Section A of the Part 2 Registration Form, the natural gas wells associated with the well pad are provided below. As of the date of this submittal, the Tiffany 2-2 and Tiffany 2-3 wells are drilled and producing.

Wellname	API Number	Latitude (NAD 83)	Longitude (NAD 83)
Tiffany 2-1	05-067-09985	37.097397° N	107.527639° W
Tiffany 2-2	05-067-09990	37.097469° N	107.527754° W
Tiffany 2-3	05-067-09989	37.097542° N	107.527868° W
Tiffany 2-4	05-067-09986	37.097253° N	107.527410° W
Tiffany 2-5	05-067-09984	37.097181° N	107.527296° W
Tiffany 2-6	05-067-09987	37.097109° N	107.527181° W

Identification and description of any air pollution control equipment and compliance monitoring devices or activities that are expected to be used at the facility:
The Caterpillar G3512B compressor engine is equipped with an oxidation catalyst and the PSI 5.7L NA generator engine is equipped with non-selective catalytic reduction and air-to-fuel ratio controller to meet emission standards required by 40 CFR part 60, subpart JJJJ for Stationary Spark Ignition Internal Combustion Engines. In accordance with 40 CFR 49.105, BP will comply with the applicable National Emission Standards for Hazardous Air Pollutants and New Source Performance Standards requirements for the affected equipment at the site. A review of the applicable standards is provided on the following pages.

Type and amount of each fuel used:
Natural Gas, see following table.

Wellsite Engine

Engine Make/Model	Fuel Consumption (MMscf/yr)
Caterpillar G3512B	80.3
Arrow VRG 330	5.1
Waukesha VRG 330	5.7
PSI 5.7L NA	3.8

Wellsite Heaters

Type	Fuel Consumption (MMscf/yr)	# Per Site	Total for Type (MMscf/yr)
0.5 MMBtu/hr TEG Dehydrator Reboiler	5.5	1	5.5
0.2 MMBtu/hr Separator Heater	2.2	4	8.8
(800-1000 Btu/scf gas)		Site Total	14.3

Type of raw materials used:
N/A

Production Rates:
The TEG dehydrator is designed for a maximum dry gas throughput of 25 MMscf per day. Other equipment emissions are not tied to production rates.

Operating Schedules:
24 hours/day, 7 days/week, 52 weeks/year.

Any existing limitations on source operations affecting emissions or any work practice standards, where applicable, for all regulated NSR pollutants at your source. Indicate all requirements referenced in the Federal Implementation Plan (FIP) for True Minor Sources in Indian Country in the Oil and Natural Gas Production and Natural Gas Processing Segments of the Oil and Natural Gas Sector that apply to emissions units and air pollution generating activities at the source or proposed. Include statements indicating each emissions unit that is an emissions unit potentially subject to the requirements referenced in the FIP, but does not meet the definition of an affected facility under the referenced requirement, and therefore, is not subject to those requirements.
40 CFR part 63, subpart DDDDD for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters – Not applicable. The site is not a major source of hazardous air pollutants (HAPs) as defined in this subpart for oil and natural gas production field facilities. Therefore, this subpart does not apply.

40 CFR part 63, subpart ZZZZ for Stationary Reciprocating Internal Combustion Engines – Applicable. The site is an area source of HAPs as defined in this subpart. The Caterpillar G3512B compressor engine (Serial No. JHH01016) and the PSI 5.7L NA generator engine (Serial No. 57L0005766) installed at the site are stationary reciprocating internal combustion engines (RICE) constructed after June 12, 2006 (based on the dates of manufacture) and have not been reconstructed since this date. Therefore, the Caterpillar G3512B compressor engine and PSI 5.7L NA generator engine are considered new stationary RICE. As required by 40 CFR 63.6590(c)(1), new stationary RICE located at an area source must meet the requirements of 40 CFR part 60, subpart JJJJ and no further Part 63 requirements apply. The Arrow VRG 330 (Serial No. P-1819) and Waukesha VRG 330 (Serial No. 399839) engines installed at the site are stationary reciprocating internal combustion engines (RICE) constructed before June 12, 2006

(based on the dates of manufacture) and have not been reconstructed since this date. Therefore, the engines are considered existing stationary RICE. As required by 40 CFR 63.6603(a), the engines (existing, non-emergency, non-black start four-stroke rich burn stationary RICE less than or equal to 500 hp and located at an area source of HAPs) must comply with the applicable maintenance requirements listed in Table 2d of this subpart. Initial notifications are not required to be submitted for the engines, as allowed by 40 CFR 63.6645(a)(5), because the engines are existing stationary RICE that are not subject to any numerical emission standards.

40 CFR part 60, subpart IIII for Stationary Compression Ignition Internal Combustion Engines – Not applicable. There are no stationary compression ignition internal combustion engines located at the site. Therefore, this subpart does not apply.

40 CFR part 60, subpart JJJJ for Stationary Spark Ignition Internal Combustion Engines – Applicable. The Caterpillar G3512B compressor engine (Serial No. JHH01016) and the PSI 5.7L NA generator engine (Serial No. 57L0005766) installed at the site are stationary spark ignition (SI) internal combustion engines and were manufactured on January 31, 2012 and August 16, 2017, respectively. Therefore, NSPS JJJJ applies to these engines. The Arrow VRG 330 (Serial No. P-1819) and Waukesha VRG 330 (Serial No. 399839) engines installed at the site are stationary SI internal combustion engines. Since the engines are non-emergency engines less than 500 hp manufactured prior to July 1, 2008 and have not been reconstructed or modified since June 12, 2006, NSPS JJJJ does not apply to the artificial lift engines.

40 CFR part 60, subpart Kb for Volatile Organic Liquid Storage Vessels – Not applicable. There are no tanks greater than 75 m^3 (472 bbl or 19,813 gal) storing volatile organic liquids at the site. Therefore, subpart Kb does not apply.

40 CFR part 60, subpart OOOOa for Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced after September 18, 2015 – Applicable. The Tiffany 2-2 and Tiffany 2-3 wells were drilled but not hydraulically fractured after September 18, 2015. Therefore, the wells are not considered well affected facilities under this subpart, however, the requirements for the collection of fugitive emissions components at a well site apply. There are no continuous bleed pneumatic controllers or natural gas-driven diaphragm pneumatic pumps located at the site. There are no storage vessels with the potential for volatile organic compounds emissions equal to or greater than six (6) tons per year at the site. The site is not an onshore natural gas processing plant as defined under this subpart. Since the site is a well site, requirements for centrifugal compressor and reciprocating compressor affected facilities do not apply. Therefore, subpart OOOOa applies for the affected sources as indicated above.

40 CFR part 63, subpart HH from Oil and Natural Gas Production Facilities – Exemption. The site is located prior to the point of custody transfer and is considered a production field facility under the subpart. HAP emissions from the glycol dehydration unit and storage vessels at the facility are less than major source thresholds. Therefore, the facility is an area source of HAPs under the subpart. The GRI-GLYCalc determination included in the submittal demonstrates uncontrolled actual average benzene emissions from the glycol dehydration unit at the facility are less than one (1) ton per year. Per 40 CFR 63.764(e)(1)(ii), the dehydration unit is exempt from the 40 CFR 63.764(d) general standards for area sources. Only recordkeeping requirements apply to the facility. Furthermore, since the facility emits less than 50% of major source thresholds as defined in this subpart, an update of the major source determination is not required annually.

40 CFR part 60, subpart KKKK for Stationary Combustion Turbines – Not applicable. There are no stationary combustion turbines located at site. Therefore, this subpart does not apply.

For each emissions unit comprising the new source or modification, estimates of the total allowable (potential to emit) annual emissions at startup of production from the air pollution source for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates:

See attached Part 2 Form and emissions calculations for the site. Potential to emit calculations are attached for the engines and dehydrator as well as the miscellaneous heaters, tanks, and fugitive components.

For each emissions unit comprising the new source or modification, estimates of the total actual annual emissions during the upcoming, consecutive 12 months from the air pollution source for the following air pollutants: particulate matter (PM, PM_{10}, $PM_{2.5}$), sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, ammonia (NH_3), fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Estimates of actual emissions must take into account equipment, operating conditions, and air pollution control measures. You should calculate an estimate of the actual annual emissions using estimated operating hours, production rates, in-place control equipment, and types of material processed, stored, or combusted.

See attached Part 2 Form and emissions calculations for the site. All estimates for this registration are based on "worst-case" emissions for the facility and thus full time maximum production estimates were made for the facility in lieu of actual emissions.

BP America Production Company
Facility: Tiffany 2 Well Pad
Description: Potential-to-Emit Emissions Summary

Emission Source Description	Emissions (tpy)													
	NOx	CO	VOC	SO2	PM	PM10	PM2.5	CH2O	Benzene	Toluene	Ethylbenzene	Xylenes	n-Hexane	Total HAPs
994 site-rated hp Caterpillar G3512B Compressor Engine with oxidation catalyst (calculations are uncontrolled)	4.7991	21.4999	9.6941	0.0189	0.3208	0.0025	0.0025	4.9910	0.0000	0.0000	0.0000	0.0000	0.0000	4.9910
58 site-rated hp Arrow VRG 330 Artificial Lift Engine	7.2532	8.0816	0.5601	0.0012	0.0396	0.0194	0.0194	0.0419	0.0000	0.0000	0.0000	0.0000	0.0000	0.0419
58 site-rated hp Waukesha VRG 330 Artificial Lift Engine	6.1606	25.2024	0.5601	0.0013	0.0444	0.0217	0.0217	0.0469	0.0000	0.0000	0.0000	0.0000	0.0000	0.0469
79 site-rated hp PSI 5.7L NA Generator Engine	0.7628	1.5257	0.5340	0.0009	0.0297	0.0145	0.0145	0.0314	0.0000	0.0000	0.0000	0.0000	0.0000	0.0314
25 MMscfd Tri-ethylene Glycol Dehydrator Still Column Vent and Flash Tank Vent[1]	0.0000	0.0000	13.7637	0.0000	0.0000	0.0000	0.0000	0.0000	0.8184	3.2507	0.5894	4.3349	0.0420	8.9934
0.5 MMBtu/hr Tri-ethylene Glycol Dehydrator Reboiler	0.2147	0.1804	0.0118	0.0013	0.0163	0.0163	0.0163	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
Miscellaneous Emissions- Heaters, Tanks, Fugitives[2]	0.3435	0.2886	0.0969	0.0021	0.0261	0.0261	0.0261	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
TOTAL	**19.1904**	**56.4898**	**25.1237**	**0.0236**	**0.4508**	**0.0744**	**0.0744**	**5.1113**	**0.8184**	**3.2507**	**0.5894**	**4.3349**	**0.0420**	**14.1049**

[1] See attached GLY-Calc run (showing uncontrolled still vent emissions).
[2] As agreed upon with EPA for registration submittals, BP is including a generic "worst case" set of ancillary equipment emissions for each wellsite facility which consists of fired separator heaters, storage tanks, and fugitive components.

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **Caterpillar G3512B Compressor Engine**

Source Information:

Rating[1], [2]	1035 hp
Site Altitude	6670 ft
Site Rating[2]	**994** hp
Hours of Operation	8760 hr/yr
Fuel Consumption[2]	7377 Btu/hp-hr

Criteria Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions per unit (lb/hr)	Emissions per unit (TPY)
NO_X[2]	0.5	g/hp-hr	1.0957	4.7991
CO[2]	2.24	g/hp-hr	4.9086	21.4999
VOC[2]	1.01	g/hp-hr	2.2133	9.6941
SO_2[3]	5.88E-04	lb/MMBtu	0.0043	0.0189
PM[3]	9.99E-03	lb/MMBtu	0.0732	0.3208
PM_{10}[3]	7.71E-05	lb/MMBtu	0.0006	0.0025
$PM_{2.5}$[3]	7.71E-05	lb/MMBtu	0.0006	0.0025
CH_2O[2]	0.52	g/hp-hr	1.1395	4.9910

Example Calculations:

NO_X Emissions (lb/hr) = 994 hp * 0.50 g/hp-hr * lb/453.6 g = 1.10

NO_X Emissions (TPY) = 1.10 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 4.80

[1] Manufacturer power rating from Compressor Systems International (CSI) for Caterpillar G3512ULB (serial number JHH01016).

[2] Caterpillar Gas Engine Site Specific Technical Data for G3512B Engine, DM9331-02-001 or DM8828-03-001, Printed February 6, 2018, for 1400 rpm, 8:1 CR, 201/130 degF aftercooler water inlet temp, ADEM3 control system, 0.5 g/hp-hr NO_x. The VOC emission factor is the sum of the NMNEHC emission factor (0.49 g/hp-hr) and the CH_2O emission factor (0.52 g/hp-hr). Derate based on Altitude Deration table at 70 degF inlet air temp. Deduct 6% for every 1,000 feet above 6000 feet.

[3] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-2 Uncontrolled Emission Factors For 4-Stroke Lean-Burn Engines, 7/00.

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **Arrow VRG 330 Artificial Lift Engine**

Source Information:

Rating[1]	68 hp
Site Altitude	6670 ft
Site Rating[1]	**58** hp
Hours of Operation	8760 hr/yr
Fuel Consumption[2]	8038 Btu/hp-hr

Criteria Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[3]	12.951	g/hp-hr	1.6560	7.2532
CO[3]	14.43	g/hp-hr	1.8451	8.0816
VOC[3]	1.0	g/hp-hr	0.1279	0.5601
SO_2[4]	5.88E-04	lb/MMBtu	0.0003	0.0012
PM[4]	1.94E-02	lb/MMBtu	0.0090	0.0396
PM_{10}[4]	9.50E-03	lb/MMBtu	0.0044	0.0194
$PM_{2.5}$[4]	9.50E-03	lb/MMBtu	0.0044	0.0194
CH_2O[4]	2.05E-02	lb/MMBtu	0.0096	0.0419

Example Calculations:

NO_X Emissions (lb/hr) = 58 hp * 12.95 g/hp-hr * lb/453.6 g = 1.66

NO_X Emissions (TPY) = 1.66 lb/hr * 8760 hr/yr * 1 Ton/2000 lb = 7.25

[1] Arrow Data Sheet page 72, 1800 rpm. Derate 3% per 1000 ft above 1500 ft for NA engines.

[2] Fuel consumption based on VR Emissions data accessed on 11/28/11 from http://www.arrowengine.com/media/VR_Emission.pdf.

[3] For NOx- Arrow best economy emissions data for VRG330 engine from VR Emissions data accessed on 11/28/11 from http://www.arrowengine.com/media/VR_Emission.pdf. For CO- Arrow 7/08 pre-catalyst emissions data for VRG 330CF engine since Arrow does not have pre-catalyst data for VRG330. Conservatively using 1.0 g/hp-hr for VOC.

[4] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-3 Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines, 7/00.

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **Waukesha VRG 330 Artificial Lift Engine**

Source Information:

Rating	68 hp
Site Altitude	6670 ft
Site Rating[1]	**58** hp
Hours of Operation	8760 hr/yr
Fuel Consumption[1]	9000 Btu/hp-hr

Criteria Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[2]	11.0	g/hp-hr	1.4065	6.1606
CO[2]	45.0	g/hp-hr	5.7540	25.2024
VOC[2]	1.0	g/hp-hr	0.1279	0.5601
SO_2[3]	5.88E-04	lb/MMBtu	0.0003	0.0013
PM[3]	1.94E-02	lb/MMBtu	0.0101	0.0444
PM_{10}[3]	9.50E-03	lb/MMBtu	0.0050	0.0217
$PM_{2.5}$[3]	9.50E-03	lb/MMBtu	0.0050	0.0217
CH_2O[3]	2.05E-02	lb/MMBtu	0.0107	0.0469

Example Calculations:

NO_X Emissions (lb/hr) = 58 hp * 11.00 g/hp-hr * lb/453.6 g = 1.41

NO_X Emissions (TPY) = 1.41 lb/hr * 8760 * 1 Ton/2000 lb = 6.16

[1] 12/81 Waukesha C884B data sheet, 1800 rpm. Derate 3% per 1000 feet above 1500 ft for NA engines.

[2] 4/4/94 Waukesha PB 397, Emission Levels VRG220/VRG330. Conservatively using 1.0 g/hp-hr VOC.

[3] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-3 Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines, 7/00.

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **PSI 5.7L NA Generator Engine**

Source Information:

Rating	94.25 hp
Site Altitude	6670 ft
Site Rating[1]	79 hp
Hours of Operation	8760 hrs/yr
Fuel Consumption[2]	4421 Btu/hp-hr

Criteria Pollutant Emissions Calculations:

Pollutant	Emission Factor	Factor Units	Emissions (lb/hr)	Emissions (TPY)
NO_X[3]	1.0	g/hp-hr	0.1742	0.7628
CO[3]	2.0	g/hp-hr	0.3483	1.5257
VOC[3]	0.7	g/hp-hr	0.1219	0.5340
SO_2[4]	5.88E-04	lb/MMBtu	0.0002	0.0009
PM[4]	1.94E-02	lb/MMBtu	0.0068	0.0297
PM_{10}[4]	9.50E-03	lb/MMBtu	0.00332	0.01453
$PM_{2.5}$[4]	9.50E-03	lb/MMBtu	0.00332	0.01453
CH_2O[4]	2.05E-02	lb/MMBtu	0.0072	0.0314

Example Calculations:

NO_X Emissions (lb/hr) = 79 hp *1.00 g/hp-hr * lb/453.6 g = 0.17

NO_X Emissions (TPY) = 0.17 lb/hr * 8760 hrs/yr * 1 Ton/2000 lb = 0.76

[1] Power Solutions International (PSI) data for 5.7L Naturally Aspirated Stationary Non-Emergency "Prime" engines, 1800 rpm. Derate 3% for every 1000 ft above 1200 ft for NA engines.

[3] Fuel consumption is 10 mcfd per email from Jim Johnson (Wellhead Compression, WCI) on June 1, 2017. Using 1000 btu/cf and rating to convert to Btu/hp-hr.

[3] Emission factors from Model Year 2017 EPA Certification. Engine is equipped with NSCR and AFRC.

[4] Based on AP-42, Fifth Edition, Volume 1, Chapter 3, Section 3.2, Table 3.2-3 Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines [Exhaust excess oxygen is 8%], 7/00.

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **0.5 MMBtu/hr Tri-ethylene Glycol Dehydrator Reboiler**

Source Information:

Number of Units	1 heater
Heater Design Burning Rate	0.5 MMBtu/hr
Hours of Operation	8,760 hr/yr

Emissions:

Pollutant	Emission Factor (lb/MMBtu)[1]	Emissions per Unit (lb/hr)	Emissions per Unit (TPY)	Total Emissions (TPY)
NO_X	0.0980	0.0490	0.2147	0.2147
CO	0.0824	0.0412	0.1804	0.1804
VOC	0.0054	0.0027	0.0118	0.0118
SO_2	0.0006	0.0003	0.0013	0.0013
PM	0.0075	0.0037	0.0163	0.0163
CH2O	0.0001	0.0000	0.0002	0.0002

Example Calculations:

NO_X Emissions (lb/hr) = 0.50 MMBtu/hr * 0.0980 lb/MMBtu = 0.0490

NO_X Emissions (TPY) = 0.05 lb/hr * 8760 hr/yr * Ton/2000 lb = 0.2147

[1] Based on AP-42, Fifth Edition, Volume 1, Chapter 1, Section 1.4, Table 1.4-1, 1.4-2, and 1.4-3, 7/98. (lb/MMscf factor converted to lb/MMbtu by dividing by 1020)

BP America Production Company
Description: **Miscellaneous Emissions- Heaters, Tanks, Fugitives**

Using a worst case set of equipment for emissions of heaters and tanks at each wellsite. Assumes that the site has four separator heaters (0.2 MMBtu/hr each), eight exempt space heaters (0.005 MMBtu/hr each), three used oil sumps, three lube oil tanks, three ethylene glycol tanks, two emulsion breaker tanks, and one methanol tank.

Source	NOx tpy	CO tpy	VOC tpy	SO2 tpy	PM tpy	CH20 tpy
Separator Heaters	0.3435	0.2886	0.0189	0.0021	0.0261	0.0003
95 bbl Used Oil Sump Tanks (3) [1]	-	-	0.0042	-	-	-
500 gal Lube Oil Tanks (3) [1]	-	-	0.0006	-	-	-
500 gal Ethylene Glycol Storage Tanks (3) [1]	-	-	0.0000	-	-	-
75 gal Emulsion Breaker Tanks (2) [1]	-	-	0.0372	-	-	-
500 gal Methanol Tank [1]	-	-	0.0139	-	-	
Fugitive Components	-	-	0.0219	-	-	-
Total	**0.3435**	**0.2886**	**0.0969**	**0.0021**	**0.0261**	**0.0003**

[1] See attached Tanks 4.0.9d runs. Since lube oil and used oil are not in the chemical database, jet kerosene is conservatively being used to estimate emissions. Used oil sumps based on 4 turnovers/year. Lube oil tanks based on 12 turnovers/year. Ethylene glycol tanks based on 12 turnovers/year. Emulsion breaker tanks based on 12 turnovers/year. Methanol tank based on 12 turnovers/yr.

BP America Production Company
Description: **Separator Heaters**

Source Information:

Number of Units	4 heaters
Heater Design Burning Rate	0.2 MMBtu/hr
Hours of Operation	8,760 hr/yr

Emissions:

Pollutant	Emission Factor (lb/MMBtu)[1]	Emissions per Unit (lb/hr)	Emissions per Unit (TPY)	Total Emissions (TPY)
NO_X	0.0980	0.0196	0.0859	0.3435
CO	0.0824	0.0165	0.0721	0.2886
VOC	0.0054	0.0011	0.0047	0.0189
SO_2	0.0006	0.0001	0.0005	0.0021
PM	0.0075	0.0015	0.0065	0.0261
CH2O	0.0001	0.0000	0.0001	0.0003

Example Calculations:

NO_X Emissions (lb/hr) = 0.20 MMBtu/hr * 0.0980 lb/MMBtu = 0.0196

NO_X Emissions (TPY) = 0.02 lb/hr * 8760 hr/yr * Ton/2000 lb = 0.0859

[1] Based on AP-42, Fifth Edition, Volume 1, Chapter 1, Section 1.4, Table 1.4-1, 1.4-2, and 1.4-3, 7/98. (lb/MMscf factor converted to lb/MMbtu by dividing by 1020)

BP America Production Company
Description: **Fugitive Emissions**

Emissions:

Equipment Type	Service	THC Emission Factor (lb/hr/source)[1]	Estimated Source Count[2]	Percent VOC[3]	VOC Emissions (lb/hr)	VOC Emissions (TPY)
Connectors	Gas	0.000440	400	0.09%	0.0002	0.0007
Flanges	Gas	0.000858	100	0.09%	0.0001	0.0003
Open-ended Lines	Gas	0.004400	0	0.09%	0.0000	0.0000
Other [4]	Gas	0.019360	50	0.09%	0.0009	0.0039
Pumps	Gas	0.005280	50	0.09%	0.0002	0.0011
Valves	Gas	0.009900	400	0.09%	0.0036	0.0159
Total			1000		**0.0050**	**0.0219**

[1] Based on EPA's "Protocol For Equipment Leak Emission Estimates", Table 2-4, November 1995. (kg/hr/source converted to lb/hr/source by multiplying by 2.2 lb/kg)

[2] Estimates only. Conservatively using estimated counts from Wolf Point CDP.

[3] Based on January 30, 2018 Gas Analysis Service Tiffany 2 Well Pad dehy inlet gas sample.

[4] Derived from compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, relief valves and vents; applied to all equipment types other than valves, pump seals, connectors, or flanges.

Example Calculations:
VOC Emissions (lb/hr) = 0.0099 lb/hr/gas valve * 400 valves * 0.09% VOC = 0.0036 lb/hr
VOC Emissions (TPY) = 0.0036 lb/hr * 8760 hr/yr * Ton/2000 lb = 0.0159 tons/year

BP America Production Company
Facility: **Tiffany 2 Well Pad**
Description: **Inlet Gas Analysis**

Analysis Type:	Inlet Gas			
Analytical Lab:	Gas Analysis Service			
Sample Date:	30-Jan-18			
		MW	Component	Wt %
Component	Mole %	lb/lb-mole	lb/lb-mole	Gas Stream
Carbon Dioxide, CO_2	8.5516	44.01	3.764	20.1383%
Hydrogen Sulfide, H_2S	0.0000	34.09	0.000	0.0000%
Nitrogen, N_2	1.5262	28.01	0.428	2.2877%
Methane, C_1H_4	89.4482	16.04	14.350	76.7846%
Ethane, C_2H_6	0.4464	30.07	0.134	0.7182%
Propane, C_3H_8	0.0126	44.10	0.006	0.0297%
i-Butane, iC_4H_{10}	0.0017	58.12	0.001	0.0053%
n-Butane, nC_4H_{10}	0.0060	58.12	0.003	0.0187%
i-Pentane, iC_5H_{12}	0.0000	72.15	0.000	0.0000%
n-Pentane, nC_5H_{12}	0.0000	72.15	0.000	0.0000%
Hexane+, C_6H_{14}+	0.0016	86.18	0.001	0.0074%
Benzene	0.0004	78.11	0.000	0.0017%
Toluene	0.0009	92.14	0.001	0.0044%
Ethylbenzene	0.0001	106.17	0.000	0.0006%
Xylenes	0.0006	106.16	0.001	0.0034%
	99.9963		18.689	100.00%
	Wt % of TOC Gas Stream that is VOC (C3+)			**0.09%**
	Wt % of Total Gas Stream that is VOC (C3+)			**0.07%**

Notes:
1. For gas mol-volume conversion, assume T = 68°F and P=14.7 psia.
2. Numbers shown in red are input values.

G3512B

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER - STAGE 2 INLET (°F):	130	FUEL:	NAT GAS
AFTERCOOLER - STAGE 1 INLET (°F):	201	FUEL SYSTEM:	CAT WIDE RANGE
JACKET WATER OUTLET (°F):	203		WITH AIR FUEL RATIO CONTROL
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig): (See note 1)	7.0-40.0
COOLING SYSTEM:	JW+OC+1AC, 2AC	FUEL METHANE NUMBER:	80
CONTROL SYSTEM:	ADEM3	FUEL LHV (Btu/scf):	905
EXHAUST MANIFOLD:	DRY	ALTITUDE CAPABILITY AT 100°F INLET AIR TEMP. (ft):	6000
COMBUSTION:	LOW EMISSION		
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	1035	776	518
ENGINE EFFICIENCY	(ISO 3046/1)	(3)	%	35.2	33.6	30.8
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	34.5	32.9	30.2
ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(4)	Btu/bhp-hr	7237	7584	8259
FUEL CONSUMPTION	(NOMINAL)	(4)	Btu/bhp-hr	7377	7731	8419
AIR FLOW (77°F, 14.7 psia)	(WET)	(5) (6)	ft3/min	2337	1836	1257
AIR FLOW	(WET)	(5) (6)	lb/hr	10364	8139	5573
FUEL FLOW (60ºF, 14.7 psia)			scfm	141	111	80
COMPRESSOR OUT PRESSURE			in Hg(abs)	99.4	91.1	68.2
COMPRESSOR OUT TEMPERATURE			°F	364	344	273
AFTERCOOLER AIR OUT TEMPERATURE			°F	134	136	134
INLET MAN. PRESSURE		(7)	in Hg(abs)	90.5	73.2	51.8
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(8)	°F	136	139	138
TIMING		(9)	°BTDC	30	28	24
EXHAUST TEMPERATURE - ENGINE OUTLET		(10)	°F	975	979	1005
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(11) (6)	ft3/min	6737	5305	3711
EXHAUST GAS MASS FLOW	(WET)	(11) (6)	lb/hr	10750	8442	5792
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)		(12)(13)	g/bhp-hr	0.50	0.50	0.50
CO		(12)(14)	g/bhp-hr	2.24	2.30	2.29
THC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	4.92	4.61	4.56
NMHC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	0.74	0.69	0.68
NMNEHC (VOCs) (mol. wt. of 15.84)		(12)(14)(15)	g/bhp-hr	0.49	0.46	0.46
HCHO (Formaldehyde)		(12)(14)	g/bhp-hr	0.52	0.54	0.62
CO2		(12)(14)	g/bhp-hr	456	482	514
EXHAUST OXYGEN		(12)(16)	% DRY	9.6	9.2	8.8
LAMBDA		(12)(16)		1.69	1.69	1.60
ENERGY BALANCE DATA						
LHV INPUT		(17)	Btu/min	127256	100022	72614
HEAT REJECTION TO JACKET WATER (JW)		(18)(26)	Btu/min	17396	14223	14146
HEAT REJECTION TO ATMOSPHERE		(19)	Btu/min	4664	3887	3110
HEAT REJECTION TO LUBE OIL (OC)		(20)(26)	Btu/min	3963	3593	3135
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		(21)(22)	Btu/min	45863	35927	25381
HEAT REJECTION TO EXHAUST (LHV TO 350°F)		(21)	Btu/min	30216	23885	17148
HEAT REJECTION TO A/C - STAGE 1 (1AC)		(23)(26)	Btu/min	6400	5038	1781
HEAT REJECTION TO A/C - STAGE 2 (2AC)		(24)(27)	Btu/min	4247	3604	2283
PUMP POWER		(25)	Btu/min	833	833	833

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	<10	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
SET POINT TIMING	-	28	28	28	28	28	28	28	29	29	29	29	30	30	30	30	30
DERATION FACTOR	0	0.50	0.63	0.75	0.88	1	1	1	1	1	1	1	1	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	1	1	1	0.97	0.91	0.84	0.77	No Rating	No Rating	No Rating
120	1	1	1	1	1	1	0.98	0.92	0.85	0.79	No Rating	No Rating	No Rating
110	1	1	1	1	1	1	0.99	0.93	0.86	0.80	No Rating	No Rating	No Rating
100	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
90	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
80	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
70	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
60	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
50	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.33	1.38	1.43	1.48	1.53	1.58	1.64	1.64	1.64	1.64	No Rating	No Rating	No Rating
120	1.26	1.31	1.36	1.41	1.46	1.51	1.57	1.57	1.57	1.57	No Rating	No Rating	No Rating
110	1.20	1.24	1.29	1.34	1.39	1.44	1.49	1.49	1.49	1.49	No Rating	No Rating	No Rating
100	1.13	1.18	1.22	1.27	1.32	1.37	1.42	1.42	1.42	1.42	1.42	No Rating	No Rating
90	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.35	1.35	1.35	1.35	No Rating	No Rating
80	1	1.04	1.09	1.13	1.18	1.23	1.28	1.28	1.28	1.28	1.28	No Rating	No Rating
70	1	1	1.02	1.07	1.11	1.16	1.21	1.21	1.21	1.21	1.21	No Rating	No Rating
60	1	1	1	1	1.04	1.09	1.14	1.14	1.14	1.14	1.14	No Rating	No Rating
50	1	1	1	1	1	1.02	1.06	1.06	1.06	1.06	1.06	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	900	900	900	900	900	920	950	980	1010	1040	No Rating	No Rating	No Rating
120	900	900	900	900	900	910	940	970	1010	1040	No Rating	No Rating	No Rating
110	900	900	900	900	900	910	940	970	1000	1030	No Rating	No Rating	No Rating
100	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
90	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
80	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
70	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
60	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
50	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor and full load set point timing required for a given fuel. Note that deration and set point timing adjustment may be required as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site. The derate factors shown do not take into account external cooling system capacity. The derate factors provided assume the external cooling system can maintain the specified cooling water temperatures, at site conditions.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/ Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See notes 26 and 27 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed's Torque for the given ambient conditions. For some ambient conditions, the engine is not capable of being loaded continuously from idle to the max site torque at the indicated speed.

NOTES:

1. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.
2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
3. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 3.0% of full load % efficiency value.
4. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 3.0% of full load data.
5. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
6. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
7. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
8. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
9. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
10. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
11. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
12. Emissions data is at engine exhaust flange prior to any after treatment.
13. NOx values are the maximum values expected under steady state conditions.
14. CO, CO2, THC, NMHC, NMNEHC, and HCHO are the maximum values expected under steady state conditions. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
15. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
16. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
17. LHV rate tolerance is ± 3.0%.
18. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
19. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
20. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
21. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
22. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
23. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
24. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
25. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
26. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (OC x 1.2) + (1AC x 1.05) + [0.85 x (1AC + 2AC) x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
27. Total Second Stage Aftercooler Circuit heat rejection is calculated as: (2AC x 1.05) + [(1AC + 2AC) x 0.15 x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	115.6	74.7	78.0	79.4	85.1	85.4	88.9	91.7	96.1	97.9	100.2
75	776	114.6	73.8	78.3	79.5	83.9	84.9	88.3	90.8	95.8	97.3	100.0
50	518	112.4	72.7	76.5	79.0	81.5	83.6	85.6	91.0	95.1	96.3	99.6

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	103.3	102.8	101.8	103.5	102.5	99.0	99.0	105.5	99.7	112.6	92.0
75	776	103.9	102.0	100.5	102.9	102.2	100.3	102.9	105.7	104.8	109.3	96.1
50	518	103.4	100.0	98.6	101.4	101.6	99.4	102.2	105.5	102.7	96.6	93.1

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	128.4	102.8	100.5	110.3	112.1	113.9	101.3	101.9	106.9	111.2	113.4
75	776	123.3	99.7	98.7	107.5	110.1	109.3	100.0	101.6	106.8	119.6	107.4
50	518	118.2	100.0	98.1	106.0	109.3	110.2	95.9	97.6	104.3	108.3	103.2

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	107.8	111.6	114.4	119.9	119.5	118.6	119.7	120.3	118.9	118.2	114.3
75	776	102.1	103.8	102.8	105.8	106.5	111.8	112.9	110.7	110.0	109.3	106.0
50	518	99.4	99.4	99.4	101.4	102.8	106.1	107.5	106.8	105.2	104.8	101.0

SOUND PARAMETER DEFINITION:

Sound Power Level Data - DM8702-03

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 3747. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 3747 and ISO 6798 for mechanical and exhaust sound level only. Frequency bands outside the displayed ranges are not measured, due to physical test, and environmental conditions that affect the accuracy of the measurement. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.

G3512B

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER - STAGE 2 INLET (°F):	130	FUEL:	NAT GAS
AFTERCOOLER - STAGE 1 INLET (°F):	201	FUEL SYSTEM:	CAT WIDE RANGE
JACKET WATER OUTLET (°F):	203		WITH AIR FUEL RATIO CONTROL
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig): (See note 1)	7.0-40.0
COOLING SYSTEM:	JW+1AC, OC+2AC	FUEL METHANE NUMBER:	80
CONTROL SYSTEM:	ADEM3	FUEL LHV (Btu/scf):	905
EXHAUST MANIFOLD:	DRY	ALTITUDE CAPABILITY AT 100°F INLET AIR TEMP. (ft):	6000
COMBUSTION:	LOW EMISSION		
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	1035	776	518
ENGINE EFFICIENCY	(ISO 3046/1)	(3)	%	35.2	33.6	30.8
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	34.5	32.9	30.2
ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(4)	Btu/bhp-hr	7237	7584	8259
FUEL CONSUMPTION	(NOMINAL)	(4)	Btu/bhp-hr	7377	7731	8419
AIR FLOW (77°F, 14.7 psia)	(WET)	(5) (6)	ft3/min	2337	1836	1257
AIR FLOW	(WET)	(5) (6)	lb/hr	10364	8139	5573
FUEL FLOW (60°F, 14.7 psia)			scfm	141	111	80
COMPRESSOR OUT PRESSURE			in Hg(abs)	99.4	91.1	68.2
COMPRESSOR OUT TEMPERATURE			°F	364	344	273
AFTERCOOLER AIR OUT TEMPERATURE			°F	134	136	134
INLET MAN. PRESSURE		(7)	in Hg(abs)	90.5	73.2	51.8
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(8)	°F	136	139	138
TIMING		(9)	°BTDC	30	28	24
EXHAUST TEMPERATURE - ENGINE OUTLET		(10)	°F	975	979	1005
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(11) (6)	ft3/min	6737	5305	3711
EXHAUST GAS MASS FLOW	(WET)	(11) (6)	lb/hr	10750	8442	5792
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)		(12)(13)	g/bhp-hr	0.50	0.50	0.50
CO		(12)(14)	g/bhp-hr	2.24	2.30	2.29
THC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	4.92	4.61	4.56
NMHC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	0.74	0.69	0.68
NMNEHC (VOCs) (mol. wt. of 15.84)		(12)(14)(15)	g/bhp-hr	0.49	0.46	0.46
HCHO (Formaldehyde)		(12)(14)	g/bhp-hr	0.52	0.54	0.62
CO2		(12)(14)	g/bhp-hr	456	482	514
EXHAUST OXYGEN		(12)(16)	% DRY	9.6	9.2	8.8
LAMBDA		(12)(16)		1.69	1.69	1.60
ENERGY BALANCE DATA						
LHV INPUT		(17)	Btu/min	127256	100022	72614
HEAT REJECTION TO JACKET WATER (JW)		(18)(26)	Btu/min	17396	14223	14146
HEAT REJECTION TO ATMOSPHERE		(19)	Btu/min	4664	3887	3110
HEAT REJECTION TO LUBE OIL (OC)		(20)(27)	Btu/min	3963	3593	3135
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		(21)(22)	Btu/min	45863	35927	25381
HEAT REJECTION TO EXHAUST (LHV TO 350°F)		(21)	Btu/min	30216	23885	17148
HEAT REJECTION TO A/C - STAGE 1 (1AC)		(23)(26)	Btu/min	6400	5038	1781
HEAT REJECTION TO A/C - STAGE 2 (2AC)		(24)(27)	Btu/min	4247	3604	2283
PUMP POWER		(25)	Btu/min	833	833	833

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	<10	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
SET POINT TIMING	-	28	28	28	28	28	28	28	29	29	29	29	30	30	30	30	30
DERATION FACTOR	0	0.50	0.63	0.75	0.88	1	1	1	1	1	1	1	1	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	1	1	1	1	1	0.97	0.91	0.84	0.77	No Rating	No Rating	No Rating
120	1	1	1	1	1	1	0.98	0.92	0.85	0.79	No Rating	No Rating	No Rating
110	1	1	1	1	1	1	0.99	0.93	0.86	0.80	No Rating	No Rating	No Rating
100	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
90	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
80	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
70	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
60	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating
50	1	1	1	1	1	1	1	0.94	0.88	0.81	0.75	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.33	1.38	1.43	1.48	1.53	1.58	1.64	1.64	1.64	1.64	No Rating	No Rating	No Rating
120	1.26	1.31	1.36	1.41	1.46	1.51	1.57	1.57	1.57	1.57	No Rating	No Rating	No Rating
110	1.20	1.24	1.29	1.34	1.39	1.44	1.49	1.49	1.49	1.49	No Rating	No Rating	No Rating
100	1.13	1.18	1.22	1.27	1.32	1.37	1.42	1.42	1.42	1.42	1.42	No Rating	No Rating
90	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.35	1.35	1.35	1.35	No Rating	No Rating
80	1	1.04	1.09	1.13	1.18	1.23	1.28	1.28	1.28	1.28	1.28	No Rating	No Rating
70	1	1	1.02	1.07	1.11	1.16	1.21	1.21	1.21	1.21	1.21	No Rating	No Rating
60	1	1	1	1	1.04	1.09	1.14	1.14	1.14	1.14	1.14	No Rating	No Rating
50	1	1	1	1	1	1.02	1.06	1.06	1.06	1.06	1.06	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	900	900	900	900	900	920	950	980	1010	1040	No Rating	No Rating	No Rating
120	900	900	900	900	900	910	940	970	1010	1040	No Rating	No Rating	No Rating
110	900	900	900	900	900	910	940	970	1000	1030	No Rating	No Rating	No Rating
100	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
90	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
80	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
70	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
60	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating
50	900	900	900	900	900	900	930	960	990	1020	1050	No Rating	No Rating

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor and full load set point timing required for a given fuel. Note that deration and set point timing adjustment may be required as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site. The derate factors shown do not take into account external cooling system capacity. The derate factors provided assume the external cooling system can maintain the specified cooling water temperatures, at site conditions.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/ Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See notes 26 and 27 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed's Torque for the given ambient conditions. For some ambient conditions, the engine is not capable of being loaded continuously from idle to the max site torque at the indicated speed.

NOTES:

1. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.
2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
3. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 3.0% of full load % efficiency value.
4. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 3.0% of full load data.
5. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
6. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
7. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
8. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
9. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
10. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
11. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
12. Emissions data is at engine exhaust flange prior to any after treatment.
13. NOx values are the maximum values expected under steady state conditions.
14. CO, CO2, THC, NMHC, NMNEHC, and HCHO are the maximum values expected under steady state conditions. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
15. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
16. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
17. LHV rate tolerance is ± 3.0%.
18. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
19. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
20. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
21. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
22. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
23. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
24. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
25. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
26. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (1AC x 1.05) + [0.85 x (1AC + 2AC) x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
27. Total Second Stage Aftercooler Circuit heat rejection is calculated as: (OC x 1.2) + (2AC x 1.05) + [(1AC + 2AC) x 0.15 x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	115.6	74.7	78.0	79.4	85.1	85.4	88.9	91.7	96.1	97.9	100.2
75	776	114.6	73.8	78.3	79.5	83.9	84.9	88.3	90.8	95.8	97.3	100.0
50	518	112.4	72.7	76.5	79.0	81.5	83.6	85.6	91.0	95.1	96.3	99.6

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	103.3	102.8	101.8	103.5	102.5	99.0	99.0	105.5	99.7	112.6	92.0
75	776	103.9	102.0	100.5	102.9	102.2	100.3	102.9	105.7	104.8	109.3	96.1
50	518	103.4	100.0	98.6	101.4	101.6	99.4	102.2	105.5	102.7	96.6	93.1

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	128.4	102.8	100.5	110.3	112.1	113.9	101.3	101.9	106.9	111.2	113.4
75	776	123.3	99.7	98.7	107.5	110.1	109.3	100.0	101.6	106.8	119.6	107.4
50	518	118.2	100.0	98.1	106.0	109.3	110.2	95.9	97.6	104.3	108.3	103.2

EXHAUST: Sound Power (1/3 Octave Frequencies)

Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
100	1035	107.8	111.6	114.4	119.9	119.5	118.6	119.7	120.3	118.9	118.2	114.3
75	776	102.1	103.8	102.8	105.8	106.5	111.8	112.9	110.7	110.0	109.3	106.0
50	518	99.4	99.4	99.4	101.4	102.8	106.1	107.5	106.8	105.2	104.8	101.0

SOUND PARAMETER DEFINITION:

Sound Power Level Data - DM8702-03

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 3747. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 3747 and ISO 6798 for mechanical and exhaust sound level only. Frequency bands outside the displayed ranges are not measured, due to physical test, and environmental conditions that affect the accuracy of the measurement. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.

Spark Ignited Features:

- Most popular Ignition System available
- Capable of operating on most Spark Ignited fuels
- Gasoline carburetion or demand regulator for gaseous fuel
- Over 40 years history of operating on Natural and well head gas.
- Aftercooling featured on VRG330TA.

Other Outstanding Features:

- Vertical in-line adjustable fan bracket
- 4 groove crankshaft pulley; 2 groove fan; 1 groove water pump; 4 groove auxillary
- Flywheel - SAE No 3 w/ring gear and SAE No 3 housing
- Lifting eyes - front and rear
- Full pressure lube oil system with full flow oil filter
- Exhaust manifold with top or rear outlets
- 10% regulated speed by mechanical governor - other governor options available
- Heavy-duty, deep skirted crankcases
- Forged steel, dynamically balanced and counterweighted crankshafts with hardened journals
- 5 main bearings on VRG220; and 7 main bearings on VRG330 models
- Replaceable precision main and rod bearings
- Overhead valve cylinder heads with replaceable guides and seats

Options: Consult factory for your requirements.

BRAKE HORSEPOWER DEDUCTIONS FOR ALTITUDE AND TEMPERATURE

Altitude: NA engines - Deduct 3% for each 1000' (305 m) above 1500' (457 m) (continuous duty), or above 500' (152 m) (intermittent duty). *VRG330TA* - Deduct 3% per 1000' (305m) above 3000' (914) (continuous duty), 3% for each 1000' (305m) above 1500' (457m) (intermittent duty)

Temperature: Deduct 1% for every 10°F. (6°C.) above 100°F. (38°C.) (continuous duty), or above 85°F. (intermittent duty). *VRG330TA* - Deduct 1% per 10°F. (5.5°C) above 100°F. (38°C) (continuous duty), 1% per 10°F. (5.5°C) above 85°F. (29°C). (intermittent duty).

Intermittent Rating (I): The highest load and speed that can be applied under specific conditions of varying lead and/or speed.

Continuous Rating (C): The load and speed that can be applied without interruption except for normal maintenance.

All ratings corrected to 500' (152 m) altitude, 29.38" (746 mm) Hg. and temperature of 85°F. (29°C.)

Natural gas ratings are based on use of 900 BTU (33.5 J/cm³) LHV gas. HD-5 propane ratings are based on use of 2335 BTU (87 J/cm³) LHV fuel.

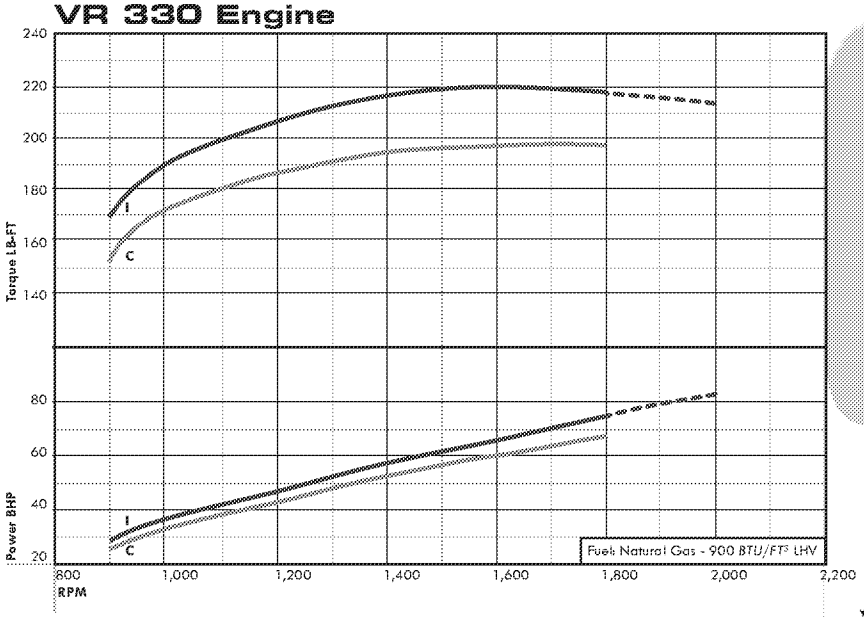
POWER RATINGS

I=INTERMITTENT C=CONTINUOUS

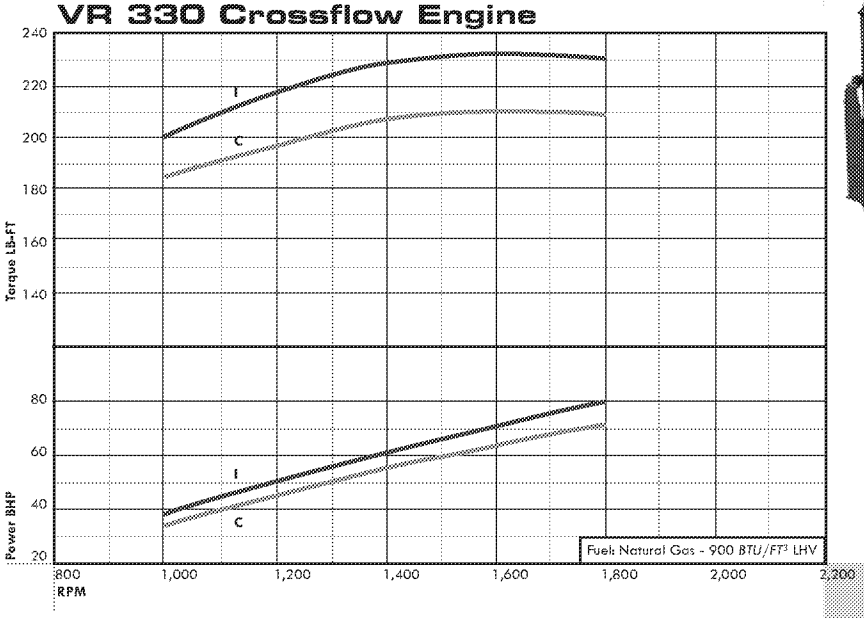
	MODEL	PEAK INTERMITTENT TORGUE @ RPM		BRAKE HORSEPOWER AT SPEEDS INDICATED (S.A.E.)													
				900		1000		1200		1400		1600		1800		2000		2200	
	Spark Ignited	FT.LB.	N*M	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C
E	VRG220, Natural Gas	148 @ 1600	201 @ 1600	19	17	24	22	31	28	39	36	45	41	50	45	55	50	59	53
N	VRG220,HD-5 Propane	191 @ 1400	259 @ 1400	29	26	33	30	43	39	51	46	56	51	61	55	66	60	71	64
G	VRG220, Gasoline	179 @ 1600	239 @ 1600	25	21	30	25	39	34	48	41	54	49	61	55	68	62	73	67
I	VRG330, Natural Gas	220 @ 1600	298 @ 1600	29	26	36	33	47	42	58	52	67	60	75	68	82	74	89	80
N	VRG330, HD-5 Propane	285 @ 1400	386 @ 1400	43	39	50	45	64	58	76	69	85	76	92	83	99	89	106	96
E	VRG330, Gasoline	268 @ 1400	360 @ 1400	35	30	44	37	60	50	75	65	65	75	95	85	105	95	110	100
U																			
N	VRG330TA NATURAL GAS					50	47	68	63	89	82	97	92	106	100	110*		118*	
I																			
T																			

Actual Horsepower may very depending upon engine configuration.

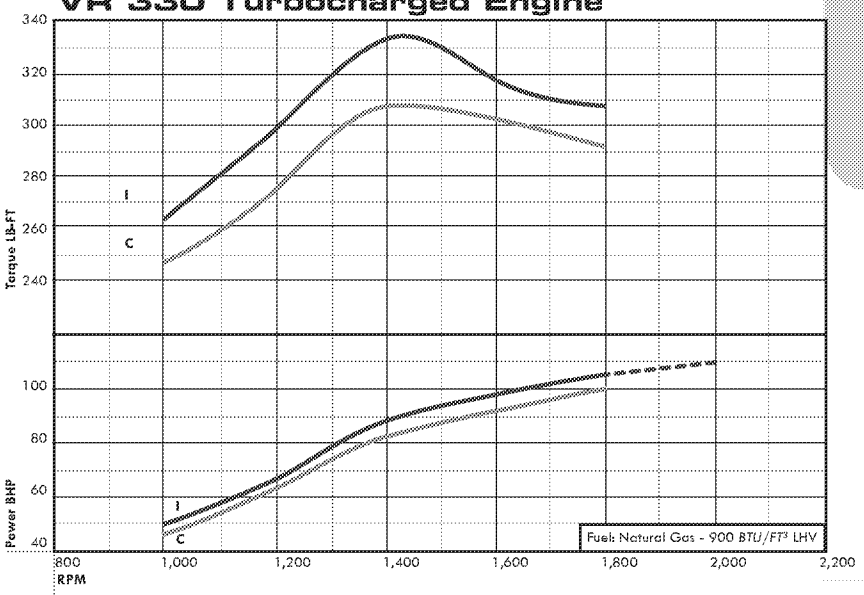
VR 330 Engine



VR 330 Crossflow Engine



VR 330 Turbocharged Engine



Model VR330
Model VR330CF - Crossflow

4 cycle, 6 cylinder, in-line

Bore and Stroke - 3.875" x 4.665" (98 x 118 mm)

Displacement - 330 cubic inch (5.4 liters)

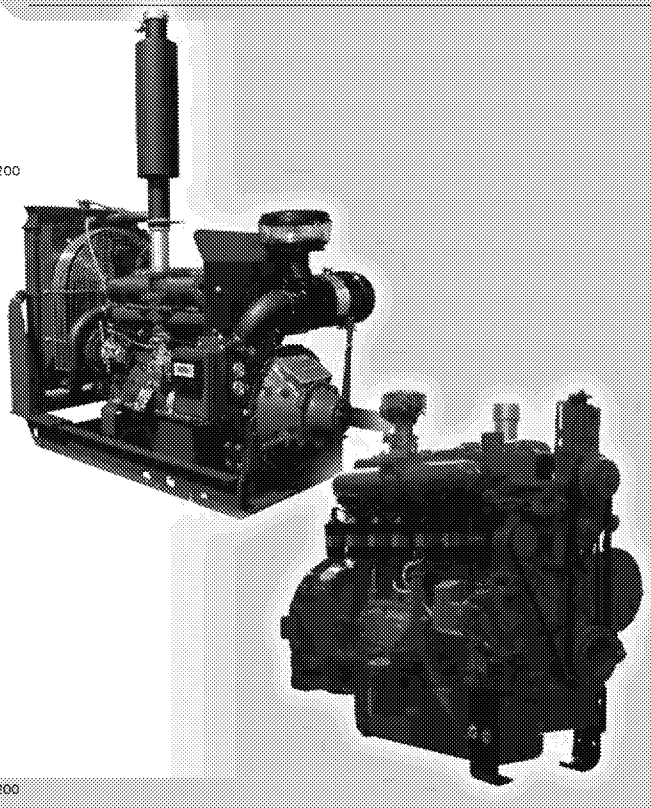
Lube Oil System - capacity-8.5 qts. (8.0 liters), including filter

Jacket Water System - capacity-8.25 qts. (7.8 liters), engine only

Dry Weight - (engine only) approximately 1,000 lbs (453 Kg)

Dry Weight - (complete GenSet) aprox. 1,800 lbs (815 Kg)

Rotation - Counterclockwise when facing flywheel



Model VR330TA - Turbocharged

4 cycle, 6 cylinder, in-line,turbocharged/aftercooled

Bore and Stroke - 3.875" x 4.665" (98 x 118 mm)

Displacement - 330 cubic inch (5.4 liters)

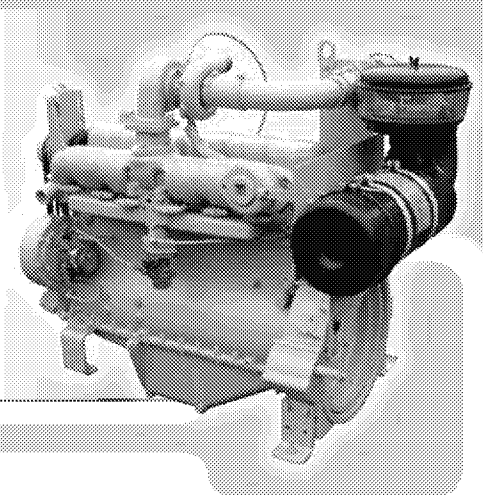
Lube Oil System - capacity-9 qts. (8.5 liters), including filter

Jacket Water System - capacity-9.25 qts. (8.8 liters), engine only

Dry Weight - (engine only) approximately 1,200 lbs (544 Kg)

Dry Weight - (complete GenSet) aprox. 2,000 lbs (907 Kg)

Rotation - Counterclockwise when facing flywheel



VR Emissions data accessed on 11/28/11 from http://www.arrowengine.com/media/VR_Emission.pdf.

BP note- Using NOx emission factor and fuel rate.

Arrow Engine Company is pleased to confirm the observed emission levels for the Arrow VRG 220 and VRG 330 spark ignited engines as follows:

Model	VRG 330TA	VRG 330HC	VRG 330/220
NO_x	10.084	12.077	12.951
CO	1.587	1.314	1.104
NMHC	.022	.053	.050

Rated HP

VRG 330TA rated at 100 Bhp at 1800 RPM.
VRG 330HC rated at 68 Bhp at 1800 RPM.
VRG 330 rated at 68 Bhp at 1800 RPM.
VRG 220 rated at 45 Bhp at 1800 RPM.

Brake HP Specific Fuel Rates

VRG 330TA rated at 7307 (Btu/Hp-hr).
VRG 330HC rated at 7312 (Btu/Hp-hr).
VRG 330 rated at 8038 (Btu/Hp-hr).

- Units for all values, grams/HP-hr.
- Values represent emissions at 100% loads.
- All tests based on pipeline quality Natural Gas of 900 Btu/ft^3 (LHV).
- Actual readings may vary based on site conditions and fuel consumption.
- Engines tested tuned for best economy.

ARROW ENGINE COMPANY - 2301 EAST INDEPENDENCE - TULSA, OKLAHOMA, USA 74110
TELEPHONE: 918-583-5711 - FAX: 918-388-3206 - www.arrowengine.com

ARROW ENGINE COMPANY
a TRIMAS company

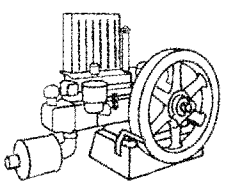
BP note- Using 330CF for conservative CO emission factor for 330. 11/11 VR emission factors are for best economy and have a lower CO factor.

We are pleased to confirm the observed emissions levels for the Arrow A42 (VRG 260), A62 (VRG 380) and A54 – CF (VRG 330 CF) spark ignited engines as below:

Model	A42/VRG 260	A62/VRG 380	A54 CF/VRG 330 CF
Nox (ppm)	1100	1150	660
CO (ppm)	4600	4800	6103
THC (ppm)	350	294	378
% O2	0.5	0.6	0.4
Stack Flow (SCF/hr)	4.05E+03	7.47E+03	6.00E+03

- Units are pre-catalyst emissions.
- Values represent emissions at 100% loads at 1800 RPM.
- All tests based on pipeline quality Natural Gas of 900 BTU/FT3 (LHV).
- Actual readings may vary based on site conditions and fuel composition.

07/2008



2301 E. Independence, Tulsa, OK 74110-4937 • 918-583-5711 • Toll-free: 1-800-331-3662
Fax: 918-388-3202 • US and Canada Fax Only 1-800-266-1481 • www.arrowengine.com

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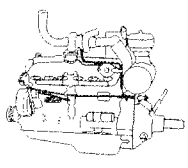


From: David Reak [DReak@arrowengine.com]
Sent: Monday, November 28, 2011 3:02 PM
To: Robert, Rebecca
Subject: RE: 220CF and 330CF Emissions

Rebecca

I had a great Thanksgiving, hope your was good as well??

The attachment you listed is the current emissions for the VRG 330 CF engine. These numbers could also be used for the VRG 220 engine, as we no long produce this engine. The emissions data on the attachment are pre-catalyst numbers, while the emissions data on the website are from the older (non-emissions - before July 1 2008) engines. The older engines data is at a "best fuel economy" setting, which means they were run leaner and had high Nox and lower CO values. With the new emissions laws the engines usually require a catalyst to meet the EPA limits, which is what is listed on the attachment.

Also there is no VRG 220 CF, the CF on the end refers to a Cross Flow head which was never done for the VRG 220 only the VRG 330. The emissions for the VRG 330, VRG 220 and VRG 330 CF are very close to each other and the emissions numbers listed will be adequate for all three. The only difference would be the exhaust flow rate, the VRG 220 would be comparable to the A42/VRG 260.

Please let me know if you have any further questions.

David Reak

Arrow Engine Company

From: Robert, Rebecca [mailto:Rebecca.Robert@bp.com]
Sent: Monday, November 28, 2011 1:35 PM
To: David Reak
Subject: 220CF and 330CF Emissions

Hi David,

I hope you had a great Thanksgiving holiday!

When you get a chance, can you please send me the latest published emissions data for the Arrow VR 220CF and 330CF engine models? I've attached the data you sent to me back in 2009. Is this still current?

Does the emissions data on the website (link below) apply to the 220CF/330CF models?

http://www.arrowengine.com/media/VR_Emission.pdf

Thanks,

Rebecca Robert
Air Specialist
BP North America Gas SPU
Regulatory Compliance & Environmental
WL1-2.100A
Office: (281) 366-3946
Cell: (713) 540-9959
Fax: (281) 366-7105

From: David Reak [mailto:DReak@arrowengine.com]
Sent: Monday, June 01, 2009 12:16 PM
To: Tanory, Rebecca L
Subject: RE: Arrow & Waukesha VRG 330 Engines

Rebecca

Attached are the emissions for the 330 CF - Please note these are at catalyst O2 settings.

I do not have anything published yet on the best economy set points for the 330CF, we usually use the standard 330 number which would be worst case. The actual numbers are 12.5 g/hp-hr Nox & 1.08 g/hp-hr CO at 100% load or 72 HP @ 1800 RPM.

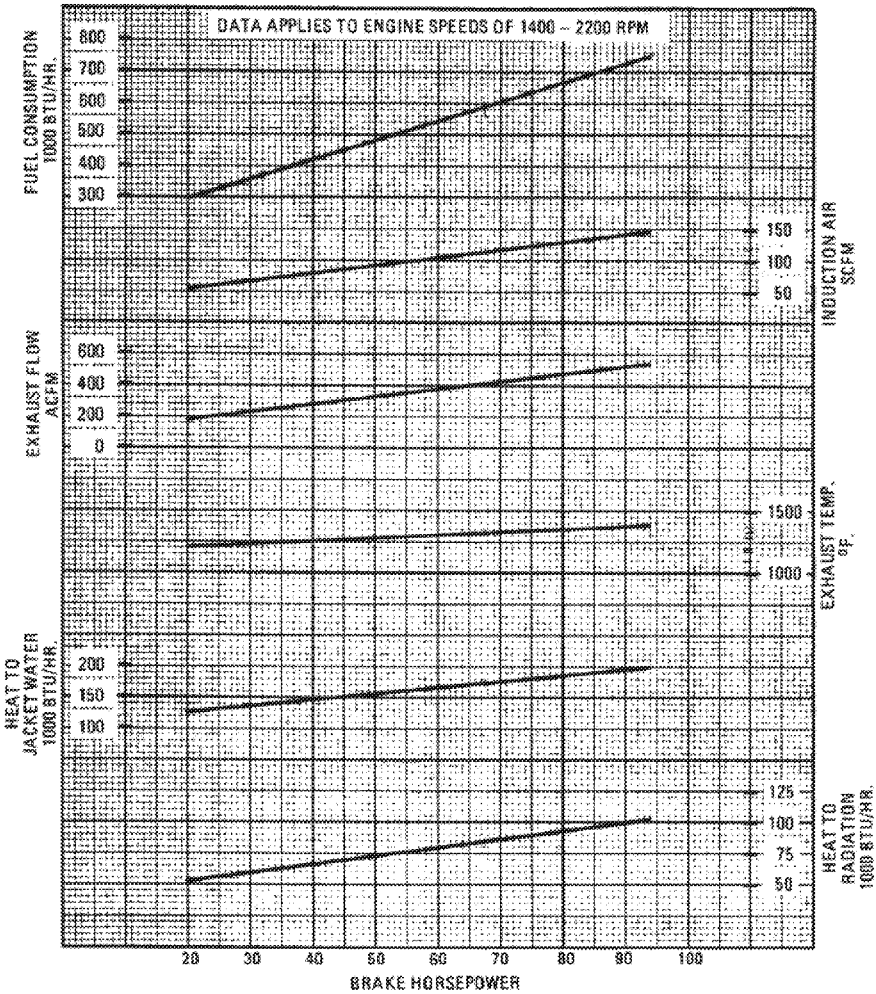
Please let me know if you have any further questions.

David Reak

Arrow Engine Company

..

ENGINE PERFORMANCE DATA – MODEL VRG330 (NATURAL GAS)



NOTES:

1. Data is based on 85° F. ambient temperature.
2. Data is average and will vary with operating conditions.
3. Exhaust Heat Recovery, BTU/HR = $\frac{0.95 \times 2380 \times Cp \times (T_2 - T_3) \times \text{Exh. Flow, ACFM}}{\text{Exh. Temp., °F} + 460}$

   Where,

   Cp = 0.27 approx. at rated load (varies with exhaust temperature and air/fuel ratio)

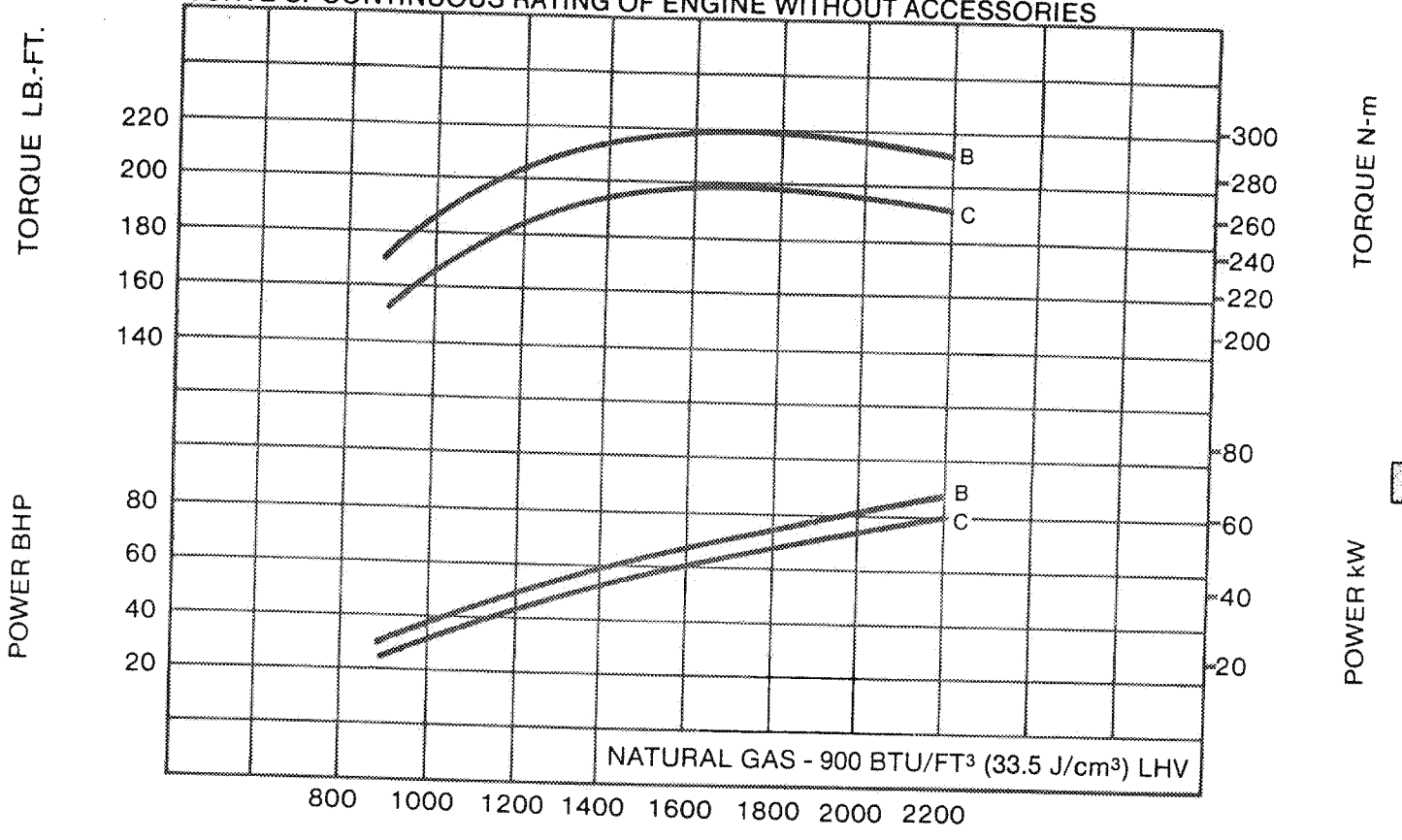
   T_2 = exhaust temp. before cooling, ° F.

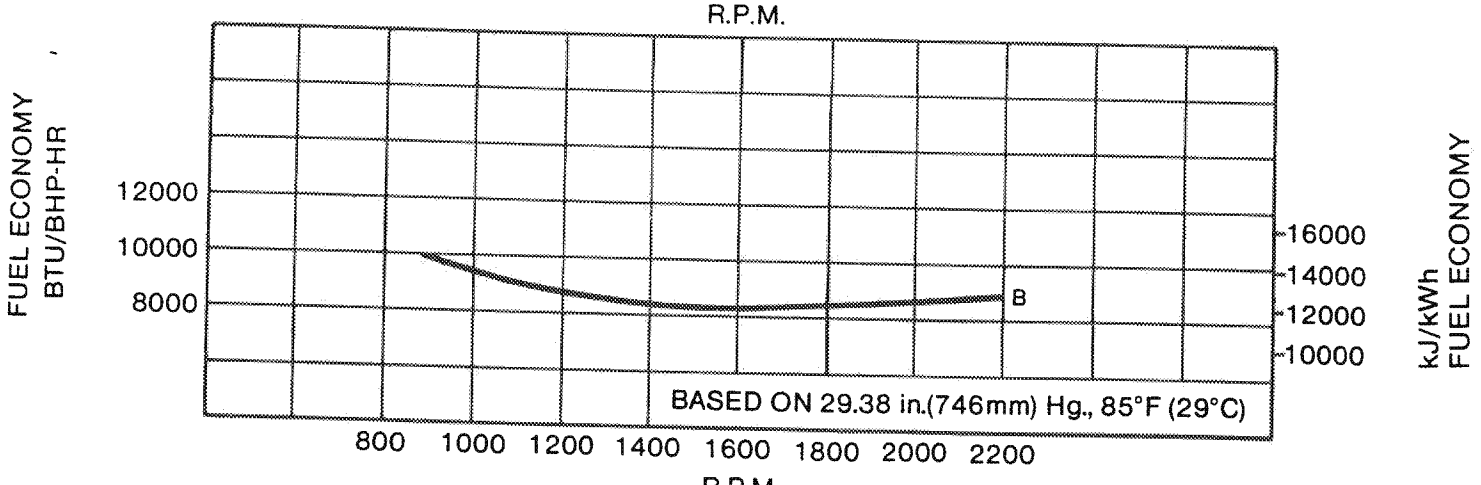
   T_3 = exhaust temp. after cooling, ° F.

   0.95 of exhaust flow is used in calculations to allow for measurements errors.
4. Ventilating air, SCFM = $\frac{\text{Heat to Radiation, BTU/HR}}{\text{Air Temp. Diff., °F.}}$

ARROW ENGINE COMPANY	ENGINE PERFORMANCE DATA MODEL VRG330 NATURAL GAS FUEL	DR JPM DATE 2/80 APP'D	S 7345-7

CURVE B: INTERMITTENT RATING OF ENGINE WITHOUT ACCESSORIES
CURVE C: CONTINUOUS RATING OF ENGINE WITHOUT ACCESSORIES





DEDUCTIONS FOR ALTITUDE AND TEMPERATURE	
RATING	
INTERMITTENT	CONTINUOUS
3% PER 1000' (305 m) ABOVE 500' (152 m) ALTITUDE	3% PER 1000' (305 m) ABOVE 1500' (457 m) ALTITUDE
1% Per 10°F (5.5°C) Above 85°F (29°C) Ambient	1% Per 10°F (5.5°C) Above 100°F (38°C) Ambient

Waukesha DRESSER

PERFORMANCE CURVES
MODEL VRG330
NATURAL GAS

DR. RHT	C
DATE 12-81	884 B
APPD. OEM	CURVE NO.

EMISSION LEVELS

VRG220/VRG330:

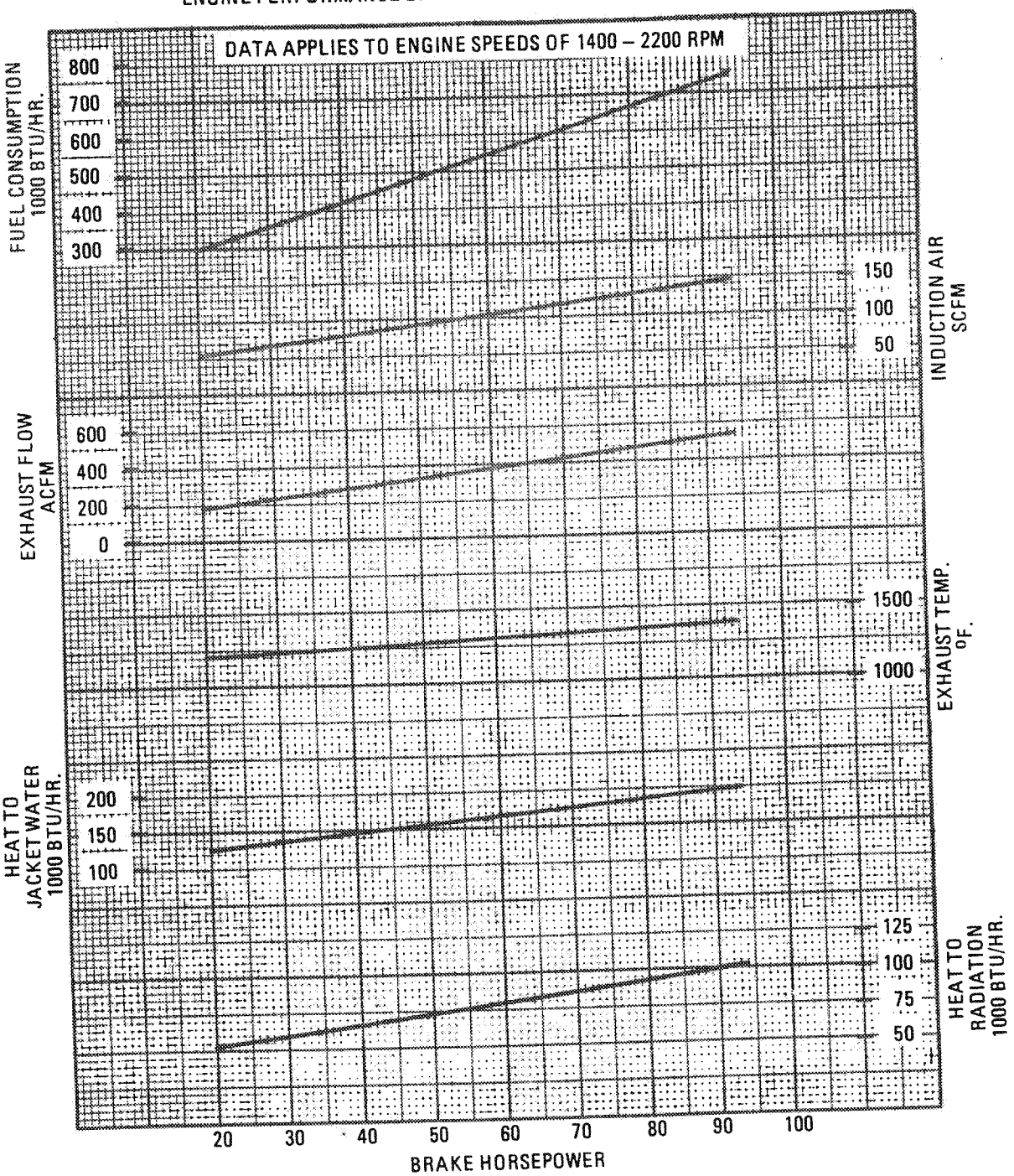
MODEL	CARBURETOR SETTING	GRAMS/HP-HR NOX*	CO	NMHC	THC	% OBSERVED DRY CO	02	MASS AFR**	VOLUME AFR**	EXCESS AIR RATIO
G	Lowest Manifold (Best Power)	7.5	45.0	0.4	2.7	1.25	0.30	15.5:1	9.3:1	0.97
G	Equal NOx & CO	9.0	9.0	0.35	2.3	0.35	0.40	16.0:1	9.6:1	1.00
G	Catalytic Conv. Input (3-way***)	8.5	16.0	0.35	2.3	0.50	0.35	15.95:1	9.6:1	0.99
G	Normal (Best Economy)	11.0	2.0	0.30	2.0	.045	1.35	17.0:1	10.2:1	1.06

*x is measured as $(NO + NO_2)_x$ and expressed as NO_2.

**Based on a natural gas fuel with a stoichiometric mass air fuel ratio of 16.05:1 and a H/C ratio of 3.85.

***Consult with individual catalyst manufacturers for their preferred carburetor set point and post catalyst emission values.

ENGINE PERFORMANCE DATA – MODEL VRG330 (NATURAL GAS)



NOTES:

1. Data is based on 85° F, ambient temperature.
2. Data is average and will vary with operating conditions.
3. Exhaust Heat Recovery, BTU/HR = $\frac{0.95 \times 2300 \times Cp \times (T_2 - T_1) \times \text{Exh. Flow, ACFM}}{\text{Exh. Temp., }^{\circ}\text{F} + 460}$

   Where,

   Cp = 0.27 approx. at rated load (varies with exhaust temperature and air/fuel ratio).

   T_2 = exhaust temp. before cooling, ° F.

   T_1 = exhaust temp. after cooling, ° F.

   0.95 of exhaust flow is used in calculations to allow for measurement errors.
4. Ventilating air, SCFM = $\frac{\text{Heat to Radiation, BTU/HR.}}{\text{Air Temp. Diff., }^{\circ}\text{F.}}$

Waukesha DRESSER

ENGINE PERFORMANCE DATA
MODEL VRG330
NATURAL GAS FUEL

DR.	JPM
DATE	2/80
APP'D	

S

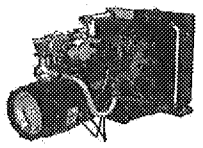
7345-7

POWER SOLUTIONS INTERNATIONAL

5.7L Naturally Aspirated Stationary

EMERGENCY "STANDBY"

Date:	10/28/2014
Rev:	C



		Units		5.7L NA			
		Std	Metric	1500		1800	
General Engine Data							
	Type	N/A		GM V-Type 4 Cycle			
	Number of cylinders	N/A		8			
	Aspiration	N/A		Naturally Aspirated			
	Bore	in	mm	4	101.6	4	101.6
	Stroke	in	mm	3.48	88.4	3.48	88.4
	Displacement	in^3	L	350	5.7	350	5.7
	Compression Ratio	N/A		9.4:1			
	RPM Range (Min-Max)	RPM		1500-1800			
	Rotation Viewed from Flywheel	N/A		Counter Clockwise			
	Firing Order	N/A		1-8-4-3-6-5-7-2			
	Dry Weight (long Block)	lb	kg	432	196	432	196
Gross Standby Power Rating[1,2] per ISO 3046 at the flywheel				HP	KW	HP	KW
	LP			94.30	70.32	113.16	84.38
	Standby Rating Average Load Factor - LP			77.32	57.66	92.79	69.19
	NG			87.28	65.08	104.73	78.10
	Standby Rating Average Load Factor - NG			71.56	53.36	85.87	64.04
Please ask a PSI sales representative for information regarding prime power operation							
Exhaust System							
	Type			Air Cooled Manifold			
	Emergency Standby Rating Catalyst Configuration for US Certified Product			No Catalyst		No Catalyst	
	Maximum allowable Back pressure	in HG	kPa	3	10.2	3	10.2
	Exhaust Volumetric Flow at Rated Power @ 1350 F	cfm	m^3/min	470.5	13.32	552.7	15.82
Air Induction System							
	Maximum allowable Intake Air Restriction with Air Cleaner						
	Clean	inH2O	kPa	3	1.49	3	1.49
	Dirty	inH2O	kPa	13	3.24	13	3.24
	Combustion Air required (volume)	cfm	m^3/min	145.70	4.13	173.00	4.90
Cooling System							
	Coolant Capacity						
	Engine only	qts	L	8.1	7.8	8.1	7.8
	Heat rejected to Cooling water at rated Load	btu/min	kcal/sec	2600	12.8	3120	13.1
	Cracking Temperature	F	C	160	71	160	71
	Full Open Temperature	F	C	185	85	185	85
Lubrication System							
	Oil Specification			SAE 5W-30 API Rating of SM or Newer			
	Maximum Allowable Oil Temperature	F	C	250	121	250	121
	Engine Oil Capacity						
	Min	Qts	L	5	4.7	5	4.7
	Max	Qts	L	5	4.7	5	4.7
Fuel System							
	Fuel Consumption @ Rated Load						
	NG	lb/hr	kg/hr	33.9	15.37	38.2	17.32
	LP	lb/hr	kg/hr	38.2	17.32	42.1	19.09
	Maximum EPR Rated Pressure	psi	kPa	1.0	6.9	1.0	6.9
	Recommended Maximum Running pressure to Electronic Pressure Regulator (EPR)	InH2O	kPa	20.0	2.7	11.0	2.7
	Recommended Minimum Running pressure to EPR	InH2O	kPa	7.0	1.7	7.0	1.7
	Minimum NG Supply Pipe Size			1-1/4" NPT			
	Minimum LPG Supply Pipe Size[4]			3/4"			

[1] Standby and overload ratings based on ISO 3046. See PSI technical standard 3630000A for additional duty cycle and engine rating information

[2] All ratings are gross flywheel horsepower corrected to 77°F at an altitude of 328feet with no cooling fan or alternator losses using heating value for NG of 1015 BTU/SCF.

[3] Production tolerances in engines and installed components can account for power variations of +/- 5%. Altitude, temperature and excessive exhaust and intake restrictions should be applied to power calculations.

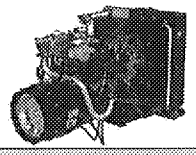
[4] The preceeding pipe sizes are only suggestions and piping sizes may vary with temperature, pressure, distance from supply and application of local codes. Gas must be available at adequate volume and pressure for engine at the EPR.

For information not listed in this document, please contact you PSI sales representative

POWER SOLUTIONS INTERNATIONAL

5.7L Naturally Aspirated Stationary

NON-EMERGENCY "PRIME"



Date:	10/28/2014
Rev:	C

		Units		5.7L NA			
		Std	Metric	1500		1800	
General Engine Data							
	Type	N/A		GM V-Type 4 Cycle			
	Number of cylinders	N/A		8			
	Aspiration	N/A		Naturally Aspirated			
	Bore	in	mm	4	101.6	4	101.6
	Stroke	in	mm	3.48	88.4	3.48	88.4
	Displacement	in^3	L	350	5.7	350	5.7
	Compression Ratio	N/A		9.4:1			
	RPM Range (Min-Max)	RPM		1500-1800			
	Rotation Viewed from Flywheel	N/A		Counter Clockwise			
	Firing Order	N/A		1-8-4-3-6-5-7-2			
	Dry Weight (long Block)	lb	kg	432	196	432	196
Gross Prime Power Rating[1,2] Per ISO 3046 at the Flywheel				HP	KW	HP	KW
	LP			84.87	63.28	101.84	75.94
	Prime Rating Average Load Factor - LP			63.65	47.46	76.38	56.95
	NG			78.55	58.57	94.25	70.29
	Prime Rating Average Load Factor - NG			58.91	43.92	70.68	52.71
Please ask a PSI sales representative for information regarding STANDBY power operation							
Exhaust System							
	Type			Air Cooled Manifold			
	Non-Emergency Prime Rating Catalyst Configuration for US Certified Product			Dual Substrate		Dual Substrate	
	Maximum allowable Back pressure	in HG	kPa	3	10.2	3	10.2
	Exhaust Volumetric Flow at Rated Power @ 1350 F	cfm	m^3/min	470.5	13.32	552.7	15.82
Air Induction System							
	Maximum allowable Intake Air Restriction with Air Cleaner						
	Clean	inH2O	kPa	3	1.49	3	1.49
	Dirty	inH2O	kPa	13	3.24	13	3.24
	Combustion Air required (volume)	cfm	m^3/min	145.70	4.13	173.00	4.90
Cooling System							
	Coolant Capacity						
	Engine only	qts	L	8.1	7.8	8.1	7.8
	Heat rejected to Cooling water at rated Load	btu/min	kcal/sec	2600	12.8	3120	13.1
	Cracking Temperature	F	C	160	71	160	71
	Full Open Temperature	F	C	185	85	185	85
Lubrication System							
	Oil Specification			SAE 5W-30 API Rating of SM or Newer			
	Maximum Allowable Oil Temperature	F	C	250	121	250	121
	Engine Oil Capacity						
	Min	Qts	L	5	4.7	5	4.7
	Max	Qts	L	5	4.7	5	4.7
Fuel System							
	Fuel Consumption @ Rated Load						
	NG	lb/hr	kg/hr	33.9	15.37	38.2	17.32
	LP	lb/hr	kg/hr	38.2	17.32	42.1	19.09
	Maximum EPR Rated Pressure	psi	kPa	1.0	6.9	1.0	6.9
	Recommended Maximum Running pressure to Electronic Pressure Regulator (EPR)	inH2O	kPa	20.0	2.7	11.0	2.7
	Recommended Minimum Running pressure to EPR	inH2O	kPa	7.0	1.7	7.0	1.7
	Minimum NG Supply Pipe Size			1-1/4" NPT			
	Minimum LPG Supply Pipe Size[4]			3/4"			

[1] Standby and overload ratings based on ISO 3046. See PSI technical standard 3630000A for additional duty cycle and engine rating information

[2] All ratings are gross flywheel horsepower corrected to 77°F at an altitude of 328feet with no cooling fan or alternator losses using heating value for NG of 1015 BTU/SCF.

[3] Production tolerances in engines and installed components can account for power variations of +/- 5%. Altitude, temperature and excessive exhaust and intake restrictions should be applied to power calculations.

[4] The preceeding pipe sizes are only suggestions and piping sizes may vary with temperature, pressure, distance from supply and application of local codes. Gas must be available at adequate volume and pressure for engine at the EPR.

For information not listed in this document, please contact you PSI sales representative

POWER SOLUTIONS INTERNATIONAL

201 Mittel Dr. Wood Dale, Il 60191
(630) 350-9400 Tel. · (630) 350-9900 Fax

PSI Technical Standard 36300000A- Engine Rating Guidelines

Emergency Standby Power Rating: Applicable for supplying emergency power for the duration of utility power outage. There is no overload capability for the emergency standby rating. Any use of the generator above the emergency standby rating is prohibited. Any unit operating in parallel with a public utility is not considered emergency standby. Emergency standby engine is applicable to a variable load with a maximum average load factor of 82% and 200 hours of operation per year. Emergency standby rating should only be applied in emergency power outages.

Prime Power Rating: Applicable for supplying electrical power in lieu of commercially purchased power or providing guaranteed standby power. The prime power rating is applicable for variable loads with limited number of operating hours per year. The average power output shall not exceed 75% of the prime power rating. The total time at 100% Prime power shall not exceed 500 hours per year. A 110% overload rating is available one hour in every twelve hours with the total hours at 110% not to exceed 25 hours per year. Maximum number of hours per year is 2500.

Continuous Power Rating: The continuous power rating is applicable for variable loads with unlimited number of operating hours per year. The power output shall not exceed 75% of the prime power rating. There is no overload capability.

POWER SOLUTIONS, INC.

655 Wheat Lane · Wood Dale, IL 60191
(630) 350-9400 Tel. · (630) 350-9900 Fax

PSI Technical Standard 36300018 - PSI Derate Specification

All PSI Engines are rated following the standards found in ISO 3046-1:2002 for gross power. When ambient conditions do not meet standard temperature, pressure and humidity the standard provides a set of equations to adjust power to ambient conditions. For turbo CAC engines the equations used for power adjustment take into account ambient temperature, pressure, charge temperature and relative humidity. For NA engine charge temperature is eliminated.

All PSI engines carry a rating tolerance of +/-5%.

When gross engine power is used to match an engine to equipment it is important to correct the power for typical engine losses. Because of the complexity of the equations used to calculate ISO power adjustments the below approximations are provide for customer's convenience. If power is critical and on the bubble OEM should test complete system to guarantee performance.

Net Power = Gross Power* – Parasitic Losses – Ambient corrections – Induction losses

Net Power is the usable power generated at the flywheel of the engine after all engine parasitic losses and ambient derates are removed. This does not account for OE equipment losses such as electrical losses for generators or hydraulic losses on pump applications.

Parasitic Losses are losses taken off for the accessories required to run and cool the engine under normal conditions and can include battery charging alternator, engine driven water pump and cooling fan.

Ambient corrections are losses taken because PSI power ratings are corrected to a standard temperature of 77°F inlet air temperature and an altitude of 1200 feet above sea level. Temperatures and altitudes greater than this standard must be accounted for as follows:

Turbo and Charge Air Cooled

- A derate of -1.5% for every 10°F over 77°F air inlet temperature must be applied.
- A derate of -2.5% for every 1000 feet above 1200 ft above sea level must be applied.

Naturally Aspirated

- A derate of -1% for every 10°F over 77°F air inlet temperature must be applied.
- A derate of -3% for every 1000 feet above 1200 ft above sea level must be applied.

Induction Losses in the engine are caused by excessive restriction on either the intake or exhaust system. Intake losses of up to 6" on the intake side and 3 inches Hg on the exhaust side do not need to be removed from the gross power. Losses greater than this will have to be accounted for in Net power calculations as follows:

- A derate of -4% must be applied for every 3.4kPa (13 in of H_2O) air inlet restriction over 6 inches H_2O.
- A derate of 1% must be applied for every 1 in of Hg increase in exhaust restriction over 3 inches of Hg.

* Gross power assumes that fuel quality meet specifications outlined in 36300017.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2017 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Power Solutions International, Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: **HPSIB5.70NGP-021**

Effective Date: 12/07/2016

Expiration Date: 12/31/2017

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 12/07/2016

Revision Date: N/A

Manufacturer: Power Solutions International, Inc.
Engine Family: HPSIB5.70NGP
Mobile/Stationary Certification Type: Mobile and Stationary
Fuel : LPG/Propane
Natural Gas (CNG/LNG)
Gasoline (up to and including 10% Ethanol)
Emission Standards :
Part 60 Subpart JJJJ Table 1
CO (g/Hp-hr) : 2.0
VOC (g/Hp-hr) : 0.7
NOx (g/Hp-hr) : 1.0
Mobile Part 1048
NMHC + NOx (g/kW-hr) : 2.7
HC + NOx (g/kW-hr) : 2.7
CO (g/kW-hr) : 4.4
Emergency Use Only : N

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR Part 1048, 40 CFR Part 60, 1065, 1068, and 60 (stationary only and combined stationary and mobile) and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following nonroad engines, by engine family, more fully described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new nonroad spark-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1048, 40 CFR Part 60. This certificate of conformity does not cover nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1048, 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1048, 40 CFR Part 60.

This certificate does not cover large nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-54)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	4.08 E+00	B
NO_x[c] <90% Load	8.47 E-01	B
CO[c] 90 - 105% Load	3.17 E-01	C
CO[c] <90% Load	5.57 E-01	B
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.47 E+00	A
Methane[g]	1.25 E+00	C
VOC[h]	1.18 E-01	C
PM10 (filterable)[i]	7.71 E-05	D
PM2.5 (filterable)[i]	7.71 E-05	D
PM Condensable[j]	9.91 E-03	D
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	<4.00 E-05	E
1,1,2-Trichloroethane[k]	<3.18 E-05	E
1,1-Dichloroethane	<2.36 E-05	E
1,2,3-Trimethylbenzene	2.30 E-05	D
1,2,4-Trimethylbenzene	1.43 E-05	C
1,2-Dichloroethane	<2.36 E-05	E
1,2-Dichloropropane	<2.69 E-05	E
1,3,5-Trimethylbenzene	3.38 E-05	D
1,3-Butadiene[k]	2.67E-04	D
1,3-Dichloropropene[k]	<2.64 E-05	E
2-Methylnaphthalene[k]	3.32 E-05	C
2,2,4-Trimethylpentane[k]	2.50 E-04	C
Acenaphthene[k]	1.25 E-06	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	5.53 E-06	C
Acetaldehyde[k,l]	8.36 E-03	A
Acrolein[k,l]	5.14 E-03	A
Benzene[k]	4.40 E-04	A
Benzo(b)fluoranthene[k]	1.66 E-07	D
Benzo(e)pyrene[k]	4.15 E-07	D
Benzo(g,h,i)perylene[k]	4.14 E-07	D
Biphenyl[k]	2.12 E-04	D
Butane	5.41 E-04	D
Butyr/Isobutyraldehyde	1.01 E-04	C
Carbon Tetrachloride[k]	<3.67 E-05	E
Chlorobenzene[k]	<3.04 E-05	E
Chloroethane	1.87 E-06	D
Chloroform[k]	<2.85 E-05	E
Chrysene[k]	6.93 E-07	C
Cyclopentane	2.27 E-04	C
Ethane	1.05 E-01	C
Ethylbenzene[k]	3.97 E-05	B
Ethylene Dibromide[k]	<4.43 E-05	E
Fluoranthene[k]	1.11 E-06	C
Fluorene[k]	5.67 E-06	C
Formaldehyde[k,l]	5.28 E-02	A
Methanol[k]	2.50 E-03	B
Methylcyclohexane	1.23 E-03	C
Methylene Chloride[k]	2.00 E-05	C
n-Hexane[k]	1.11 E-03	C
n-Nonane	1.10 E-04	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
n-Octane	3.51 E-04	C
n-Pentane	2.60 E-03	C
Naphthalene[k]	7.44 E-05	C
PAH[k]	2.69 E-05	D
Phenanthrene[k]	1.04 E-05	D
Phenol[k]	2.40 E-05	D
Propane	4.19 E-02	C
Pyrene[k]	1.36 E-06	C
Styrene[k]	<2.36 E-05	E
Tetrachloroethane[k]	2.48 E-06	D
Toluene[k]	4.08 E-04	B
Vinyl Chloride[k]	1.49 E-05	C
Xylene[k]	1.84 E-04	B

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (1/\text{operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and

h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES[a]
(SCC 2-02-002-53)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	2.21 E+00	A
NO_x[c] <90% Load	2.27 E+00	C
CO[c] 90 - 105% Load	3.72 E+00	A
CO[c] <90% Load	3.51 E+00	C
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	3.58 E-01	C
Methane[g]	2.30 E-01	C
VOC[h]	2.96 E-02	C
PM10 (filterable)[i,j]	9.50 E-03	E
PM2.5 (filterable)[j]	9.50 E-03	E
PM Condensable[k]	9.91 E-03	E
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[l]	2.53 E-05	C
1,1,2-Trichloroethane[l]	<1.53 E-05	E
1,1-Dichloroethane	<1.13 E-05	E
1,2-Dichloroethane	<1.13 E-05	E
1,2-Dichloropropane	<1.30 E-05	E
1,3-Butadiene[l]	6.63 E-04	D
1,3-Dichloropropene[l]	<1.27 E-05	E
Acetaldehyde[l,m]	2.79 E-03	C
Acrolein[l,m]	2.63 E-03	C
Benzene[l]	1.58 E-03	B
Butyr/isobutyraldehyde	4.86 E-05	D
Carbon Tetrachloride[l]	<1.77 E-05	E

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES (Concluded)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Chlorobenzene[l]	<1.29 E-05	E
Chloroform[l]	<1.37 E-05	E
Ethane[n]	7.04 E-02	C
Ethylbenzene[l]	<2.48 E-05	E
Ethylene Dibromide[l]	<2.13 E-05	E
Formaldehyde[l,m]	2.05 E-02	A
Methanol[l]	3.06 E-03	D
Methylene Chloride[l]	4.12 E-05	C
Naphthalene[l]	<9.71 E-05	E
PAH[l]	1.41 E-04	D
Styrene[l]	<1.19 E-05	E
Toluene[l]	5.58 E-04	A
Vinyl Chloride[l]	<7.18 E-06	E
Xylene[l]	1.95 E-04	A

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM-10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})(\text{heat input, MMBtu/hr})(1/\text{operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2,

C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6 scf.

[f] Emission factor for TOC is based on measured emission levels from 6 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds. Methane and ethane emissions were not measured for this engine category.

[i] No data were available for uncontrolled engines. PM10 emissions are for engines equipped with a PCC.

[j] Considered ≤ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[k] No data were available for condensable emissions. The presented emission factor reflects emissions from 4SLB engines.

[l] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[m] For rich-burn engines, no interference is suspected in quantifying aldehyde emissions. The presented emission factors are based on FTIR and CARB 430 emissions data measurements.

[n] Ethane emission factor is determined by subtracting the VOC emission factor from the NMHC emission factor.

References For Section 3.2

1. *Engines, Turbines, And Compressors Directory*, American Gas Association, Catalog #XF0488.

2. *Standards Support And Environmental Impact Statement, Volume I: Stationary Internal Combustion Engines*, EPA-450/2-78-125a, U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1979.

3. *Alternative Control Techniques Document - NO_x Emissions From Stationary Reciprocating Engines*, EPA-453/R-93-032, July 1993.

4. *Handbook - Control Technologies For Hazardous Air Pollutants*, EPA-625/6-91-014, June 1991.

5. *Limiting Net Greenhouse Gas Emissions In The United States, Volume II: Energy Responses,* Report for the Office of Environmental Analysis, Office of Policy, Planning and Analysis, Department of Energy (DOE), DOE/PE-0101 Volume II, September 1991.

6. C. Castaldini, *NO_x Reduction Technologies For Natural Gas Industry Prime Movers*, GRI-90/0215, Gas Research Institute, Chicago, IL, August 1990.

7. *Emission Factor Documentation for AP-42 Section 3.2, Natural Gas-Fired Reciprocating Engines*, EPA Contract No. 68-D2-0160, Alpha-Gamma Technologies, Inc., Raleigh, North Carolina, July 2000.

2030 Afton Place
Farmington, NM 87401
(505) 325-6622

Analysis No: BN180033
Cust No: 15800-15505

Well/Lease Information

Customer Name:	BP - NORTH	Source:	DEHY BEFORE SEP
Well Name:	TIFFANY PAD 2 DEHY	Well Flowing:	
County/State:	CO	Pressure:	360 PSIG
Location:		Flow Temp:	90 DEG. F
Field:		Ambient Temp:	52 DEG. F
Formation:		Flow Rate:	MCF/D
Cust. Stn. No.:		Sample Method:	Purge & Fill
		Sample Date:	01/30/2018
		Sample Time:	2.20 PM
		Sampled By:	KEVIN IRELAND
Heat Trace:	N/A	Sampled by (CO):	BP
Remarks:	SAMPLE BROUGHT IN ON 02/01/2018 @ 1600 HOURS.		

Analysis

Component:	Mole%:	Unormalized %:	**GPM:	*BTU:	*SP Gravity:
Nitrogen	1.5262	1.5362	0.1680	0.00	0.0148
CO2	8.5516	8.6078	1.4620	0.00	0.1299
Methane	89.4482	90.0358	15.1940	903.43	0.4955
Ethane	0.4464	0.4493	0.1200	7.90	0.0046
Propane	0.0126	0.0127	0.0030	0.32	0.0002
Iso-Butane	0.0017	0.0017	0.0010	0.05	0.0000
N-Butane	0.0060	0.0060	0.0020	0.19	0.0001
Neopentane 2,2 dmc3	0.0000	0.0000	0.0000	0.00	0.0000
I-Pentane	0.0000	0.0000	0.0000	0.00	0.0000
N-Pentane	0.0000	0.0000	0.0000	0.00	0.0000
Neohexane	0.0000	N/R	0.0000	0.00	0.0000
2-3-Dimethylbutane	0.0000	N/R	0.0000	0.00	0.0000
Cyclopentane	0.0000	N/R	0.0000	0.00	0.0000
2-Methylpentane	0.0002	N/R	0.0000	0.01	0.0000
3-Methylpentane	0.0003	N/R	0.0000	0.01	0.0000
C6	0.0005	0.0074	0.0000	0.02	0.0000
Methylcyclopentane	0.0004	N/R	0.0000	0.02	0.0000
Benzene	0.0004	N/R	0.0000	0.01	0.0000
Cyclohexane	0.0002	N/R	0.0000	0.01	0.0000
2-Methylhexane	0.0000	N/R	0.0000	0.00	0.0000
3-Methylhexane	0.0000	N/R	0.0000	0.00	0.0000
2-2-4-Trimethylpentane	0.0000	N/R	0.0000	0.00	0.0000
i-heptanes	0.0000	N/R	0.0000	0.00	0.0000
Heptane	0.0008	N/R	0.0000	0.04	0.0000

Methylcyclohexane	0.0007	N/R	0.0000	0.04	0.0000
Toluene	0.0009	N/R	0.0000	0.04	0.0000
2-Methylheptane	0.0001	N/R	0.0000	0.01	0.0000
4-Methylheptane	0.0001	N/R	0.0000	0.01	0.0000
i-Octanes	0.0001	N/R	0.0000	0.01	0.0000
Octane	0.0005	N/R	0.0000	0.03	0.0000
Ethylbenzene	0.0001	N/R	0.0000	0.01	0.0000
m, p Xylene	0.0005	N/R	0.0000	0.03	0.0000
o Xylene (& 2,2,4 tmc7)	0.0001	N/R	0.0000	0.01	0.0000
i-C9	0.0004	N/R	0.0000	0.03	0.0000
C9	0.0002	N/R	0.0000	0.01	0.0000
i-C10	0.0003	N/R	0.0000	0.02	0.0000
C10	0.0003	N/R	0.0000	0.02	0.0000
i-C11	0.0000	N/R	0.0000	0.00	0.0000
C11	0.0000	N/R	0.0000	0.00	0.0000
C12P	0.0000	N/R	0.0000	0.00	0.0000
Total	100.00	100.657	16.950	912.27	0.6454

* @ 14.730 PSIA DRY & UNCORRECTED FOR COMPRESSIBILITY
**@ 14.730 PSIA & 60 DEG. F.

COMPRESSIBLITY FACTOR (1/Z):	1.0022	CYLINDER #:	3833
BTU/CU.FT IDEAL:	914.4	CYLINDER PRESSURE:	343 PSIG
BTU/CU.FT (DRY) CORRECTED FOR (1/Z):	916.4	ANALYSIS DATE:	02/02/2018
BTU/CU.FT (WET) CORRECTED FOR (1/Z):	900.5	ANALYIS TIME:	11:09:04 AM
DRY BTU @ 15.025:	934.8	ANALYSIS RUN BY:	CAMERON MANGAN
REAL SPECIFIC GRAVITY:	0.6466		

GPM, BTU, and SPG calculations as shown above are based on current GPA constants.
GPA Standard: GPA 2286-14
GC: SRI Instruments 8610 **Last Cal/Verify: 02/02/2018**
GC Method: C12+BTEX Gas

BP - NORTH

WELL ANALYSIS COMPARISON

Lease: TIFFANY PAD 2 DEHY | DEHY BEFORE SEP | 02/02/2018

Stn. No.: | 15800-15505

Mtr. No.:

Smpl Date:	01/30/2018
Test Date:	02/02/2018
Run No:	BN180033
Nitrogen:	1.5262
CO2:	8.5516
Methane:	89.4482
Ethane:	0.4464
Propane:	0.0126
I-Butane:	0.0017
N-Butane:	0.0060
2,2 dmc3:	0.0000
I-Pentane:	0.0000
N-Pentane:	0.0000
Neohexane:	0.0000
2-3-	0.0000
Cyclopentane:	0.0000
2-Methylpentane:	0.0002
3-Methylpentane:	0.0003
C6:	0.0005
Methylcyclopentane:	0.0004
Benzene:	0.0004
Cyclohexane:	0.0002
2-Methylhexane:	0.0000
3-Methylhexane:	0.0000
2-2-4-	0.0000
i-heptanes:	0.0000
Heptane:	0.0008
Methylcyclohexane:	0.0007
Toluene:	0.0009
2-Methylheptane:	0.0001
4-Methylheptane:	0.0001
i-Octanes:	0.0001
Octane:	0.0005
Ethylbenzene:	0.0001
m, p Xylene:	0.0005
o Xylene (& 2,2,4	0.0001
i-C9:	0.0004
C9:	0.0002
i-C10:	0.0003
C10:	0.0003
i-C11:	0.0000
C11:	0.0000
C12P:	0.0000
BTU:	916.4
GPM:	16.9530
SPG:	0.6466

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: PTE - Tiffany 2 Well Pad 25 MMscfd, 8.4 gpm
File Name: \\Ramxtxss022-f01\hou_group_016\SanJuan\HSE\Environmental\San Juan Air\Colorado\mNSR Registrations - Indian Land\TIFFANY 2\Part 2\Backup\Tiffany 2 Pad Dehy 25 MMscfd 8.4 gpm.ddf
Date: February 07, 2018

DESCRIPTION:

Description: 1/30/18 Tiffany Pad 2 dehy wet gas sample, 25 MMscfd design, 7 lb water/MMscf default, wet gas 90 degF & 343 psig, flash tnk 120 degF & 125 psig, stripping gas, lean glycol 0.9% water, 2 Rotor-tech GA4-10 max design 4.2 gpm x 2 (8.4 gpm)

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 90.00 deg. F
Pressure: 343.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	8.5516
Nitrogen	1.5262
Methane	89.4482
Ethane	0.4464
Propane	0.0126
Isobutane	0.0017
n-Butane	0.0060
n-Hexane	0.0005
Cyclohexane	0.0002
Other Hexanes	0.0009
Heptanes	0.0008
Methylcyclohexane	0.0007
Benzene	0.0004
Toluene	0.0009
Ethylbenzene	0.0001
Xylenes	0.0006
C8+ Heavies	0.0020

DRY GAS:

Flow Rate: 25.0 MMSCF/day
Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 0.9 wt% H2O
Flow Rate: 8.4 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

FLASH TANK:

Flash Control: Vented to atmosphere
Temperature: 120.0 deg. F
Pressure: 125.0 psig

STRIPPING GAS:

Source of Gas: Dry Gas
Gas Flow Rate: 8.400 scfm

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: PTE - Tiffany 2 Well Pad 25 MMscfd, 8.4 gpm
File Name: \\Ramxtxss022-f01\hou_group_016\SanJuan\HSE\Environmental\San Juan Air\Colorado\mNSR Registrations - Indian Land\TIFFANY 2\Part 2\Backup\Tiffany 2 Pad Dehy 25 MMscfd 8.4 gpm.ddf
Date: February 07, 2018

DESCRIPTION:

Description: 1/30/18 Tiffany Pad 2 dehy wet gas sample, 25 MMscfd design, 7 lb water/MMscf default, wet gas 90 degF & 343 psig, flash tnk 120 degF & 125 psig, stripping gas, lean glycol 0.9% water, 2 Rotor-tech GA4-10 max design 4.2 gpm x 2 (8.4 gpm)

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	21.0520	505.249	92.2079
Ethane	0.2604	6.249	1.1404
Propane	0.0159	0.382	0.0697
Isobutane	0.0040	0.096	0.0174
n-Butane	0.0183	0.439	0.0802
n-Hexane	0.0067	0.160	0.0292
Cyclohexane	0.0125	0.301	0.0549
Other Hexanes	0.0087	0.208	0.0380
Heptanes	0.0285	0.683	0.1247
Methylcyclohexane	0.0664	1.593	0.2908
Benzene	0.1839	4.415	0.8057
Toluene	0.7349	17.637	3.2187
Ethylbenzene	0.1338	3.211	0.5860
Xylenes	0.9858	23.658	4.3177
C8+ Heavies	0.8450	20.280	3.7011
Total Emissions	24.3567	584.560	106.6822
Total Hydrocarbon Emissions	24.3567	584.560	106.6822
Total VOC Emissions	3.0443	73.062	13.3338
Total HAP Emissions	2.0450	49.080	8.9571
Total BTEX Emissions	2.0383	48.920	8.9279

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	39.4405	946.573	172.7495
Ethane	0.4526	10.861	1.9822
Propane	0.0219	0.526	0.0960
Isobutane	0.0045	0.107	0.0196
n-Butane	0.0174	0.417	0.0762
n-Hexane	0.0029	0.070	0.0128
Cyclohexane	0.0015	0.035	0.0064
Other Hexanes	0.0049	0.116	0.0212

Heptanes	0.0063	0.151	0.0276
Methylcyclohexane	0.0060	0.144	0.0262
Benzene	0.0029	0.070	0.0127
Toluene	0.0073	0.175	0.0320
Ethylbenzene	0.0008	0.019	0.0034
Xylenes	0.0039	0.094	0.0172
C8+ Heavies	0.0180	0.431	0.0786
Total Emissions	39.9913	959.790	175.1617
Total Hydrocarbon Emissions	39.9913	959.790	175.1617
Total VOC Emissions	0.0982	2.356	0.4299
Total HAP Emissions	0.0178	0.428	0.0781
Total BTEX Emissions	0.0149	0.358	0.0653

EQUIPMENT REPORTS:

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages:	1.25	
Calculated Dry Gas Dew Point:	4.13	lbs. H2O/MMSCF
Temperature:	90.0	deg. F
Pressure:	343.0	psig
Dry Gas Flow Rate:	25.0000	MMSCF/day
Glycol Losses with Dry Gas:	0.0816	lb/hr
Wet Gas Water Content:	Saturated	
Calculated Wet Gas Water Content:	102.84	lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	4.90	gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.00%	96.00%
Carbon Dioxide	99.79%	0.21%
Nitrogen	99.99%	0.01%
Methane	99.99%	0.01%
Ethane	99.95%	0.05%
Propane	99.89%	0.11%
Isobutane	99.83%	0.17%
n-Butane	99.77%	0.23%
n-Hexane	99.33%	0.67%
Cyclohexane	97.11%	2.89%
Other Hexanes	99.50%	0.50%
Heptanes	98.56%	1.44%
Methylcyclohexane	96.30%	3.70%
Benzene	78.35%	21.65%
Toluene	67.53%	32.47%
Ethylbenzene	53.97%	46.03%
Xylenes	43.53%	56.47%
C8+ Heavies	90.91%	9.09%

FLASH TANK

Flash Control: Vented to atmosphere
Flash Temperature: 120.0 deg. F
Flash Pressure: 125.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.97%	0.03%
Carbon Dioxide	38.71%	61.29%
Nitrogen	4.71%	95.29%
Methane	4.81%	95.19%
Ethane	15.36%	84.64%
Propane	28.03%	71.97%
Isobutane	37.36%	62.64%
n-Butane	44.03%	55.97%
n-Hexane	67.80%	32.20%
Cyclohexane	89.79%	10.21%
Other Hexanes	61.55%	38.45%
Heptanes	81.40%	18.60%
Methylcyclohexane	91.96%	8.04%
Benzene	98.52%	1.48%
Toluene	99.09%	0.91%
Ethylbenzene	99.48%	0.52%
Xylenes	99.65%	0.35%
C8+ Heavies	98.16%	1.84%

REGENERATOR

Regenerator Stripping Gas:
Dry Product Gas
Stripping Gas Flow Rate: 8.4000 scfm

Component	Remaining in Glycol	Distilled Overhead
Water	29.22%	70.78%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
n-Hexane	0.65%	99.35%
Cyclohexane	3.46%	96.54%
Other Hexanes	1.37%	98.63%
Heptanes	0.58%	99.42%
Methylcyclohexane	4.25%	95.75%
Benzene	5.06%	94.94%
Toluene	7.95%	92.05%
Ethylbenzene	10.44%	89.56%
Xylenes	12.93%	87.07%
C8+ Heavies	12.14%	87.86%

STREAM REPORTS:

WET GAS STREAM

Temperature: 90.00 deg. F
Pressure: 357.70 psia
Flow Rate: 1.04e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.17e-001	1.07e+002
Carbon Dioxide	8.53e+000	1.03e+004
Nitrogen	1.52e+000	1.17e+003
Methane	8.93e+001	3.94e+004
Ethane	4.45e-001	3.69e+002
Propane	1.26e-002	1.53e+001
Isobutane	1.70e-003	2.71e+000
n-Butane	5.99e-003	9.58e+000
n-Hexane	4.99e-004	1.18e+000
Cyclohexane	2.00e-004	4.62e-001
Other Hexanes	8.98e-004	2.13e+000
Heptanes	7.98e-004	2.20e+000
Methylcyclohexane	6.98e-004	1.89e+000
Benzene	3.99e-004	8.58e-001
Toluene	8.98e-004	2.28e+000
Ethylbenzene	9.98e-005	2.92e-001
Xylenes	5.99e-004	1.75e+000
C8+ Heavies	2.00e-003	9.36e+000
Total Components	100.00	5.14e+004

DRY GAS STREAM

Temperature: 90.00 deg. F
Pressure: 357.70 psia
Flow Rate: 1.04e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.69e-003	4.30e+000
Carbon Dioxide	8.54e+000	1.03e+004
Nitrogen	1.53e+000	1.17e+003
Methane	8.95e+001	3.94e+004
Ethane	4.46e-001	3.68e+002
Propane	1.26e-002	1.52e+001
Isobutane	1.70e-003	2.71e+000
n-Butane	5.99e-003	9.55e+000
n-Hexane	4.97e-004	1.18e+000
Cyclohexane	1.94e-004	4.49e-001
Other Hexanes	8.96e-004	2.12e+000
Heptanes	7.89e-004	2.17e+000
Methylcyclohexane	6.74e-004	1.82e+000
Benzene	3.13e-004	6.72e-001
Toluene	6.08e-004	1.54e+000
Ethylbenzene	5.40e-005	1.57e-001
Xylenes	2.61e-004	7.62e-001
C8+ Heavies	1.82e-003	8.51e+000

Total Components	100.00	5.13e+004

LEAN GLYCOL STREAM

Temperature: 90.00 deg. F
Flow Rate: 8.40e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.91e+001	4.69e+003
Water	9.00e-001	4.26e+001
Carbon Dioxide	4.64e-011	2.20e-009
Nitrogen	3.48e-013	1.65e-011
Methane	3.82e-018	1.81e-016
Ethane	1.97e-009	9.32e-008
Propane	1.42e-011	6.71e-010
Isobutane	2.96e-012	1.40e-010
n-Butane	1.17e-011	5.53e-010
n-Hexane	8.41e-007	3.98e-005
Cyclohexane	9.32e-006	4.41e-004
Other Hexanes	2.25e-006	1.07e-004
Heptanes	3.37e-006	1.59e-004
Methylcyclohexane	6.14e-005	2.91e-003
Benzene	2.07e-004	9.78e-003
Toluene	1.34e-003	6.34e-002
Ethylbenzene	3.29e-004	1.56e-002
Xylenes	3.09e-003	1.46e-001
C8+ Heavies	2.46e-003	1.16e-001
Total Components	100.00	4.73e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 90.00 deg. F
Pressure: 357.70 psia
Flow Rate: 8.77e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.54e+001	4.69e+003
Water	2.97e+000	1.46e+002
Carbon Dioxide	6.40e-001	3.14e+001
Nitrogen	2.52e-002	1.24e+000
Methane	8.44e-001	4.14e+001
Ethane	1.09e-002	5.35e-001
Propane	6.20e-004	3.05e-002
Isobutane	1.46e-004	7.15e-003
n-Butane	6.33e-004	3.11e-002
n-Hexane	1.84e-004	9.04e-003
Cyclohexane	2.89e-004	1.42e-002
Other Hexanes	2.57e-004	1.26e-002
Heptanes	6.90e-004	3.39e-002
Methylcyclohexane	1.51e-003	7.44e-002
Benzene	4.00e-003	1.96e-001
Toluene	1.64e-002	8.05e-001
Ethylbenzene	3.06e-003	1.50e-001
Xylenes	2.31e-002	1.14e+000

Component	Conc. (vol%)	Loading (lb/hr)
C8+ Heavies	1.99e-002	9.75e-001
Total Components	100.00	4.91e+003

FLASH TANK OFF GAS STREAM

Temperature: 120.00 deg. F
Pressure: 139.70 psia
Flow Rate: 1.12e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.81e-002	4.69e-002
Carbon Dioxide	1.48e+001	1.93e+001
Nitrogen	1.42e+000	1.18e+000
Methane	8.31e+001	3.94e+001
Ethane	5.09e-001	4.53e-001
Propane	1.68e-002	2.19e-002
Isobutane	2.61e-003	4.48e-003
n-Butane	1.01e-002	1.74e-002
n-Hexane	1.14e-003	2.91e-003
Cyclohexane	5.83e-004	1.45e-003
Other Hexanes	1.90e-003	4.85e-003
Heptanes	2.13e-003	6.30e-003
Methylcyclohexane	2.06e-003	5.98e-003
Benzene	1.26e-003	2.90e-003
Toluene	2.68e-003	7.31e-003
Ethylbenzene	2.46e-004	7.73e-004
Xylenes	1.25e-003	3.93e-003
C8+ Heavies	3.56e-003	1.80e-002
Total Components	100.00	6.05e+001

FLASH TANK GLYCOL STREAM

Temperature: 120.00 deg. F
Flow Rate: 8.64e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.66e+001	4.69e+003
Water	3.00e+000	1.46e+002
Carbon Dioxide	2.51e-001	1.22e+001
Nitrogen	1.20e-003	5.84e-002
Methane	4.11e-002	1.99e+000
Ethane	1.69e-003	8.21e-002
Propane	1.76e-004	8.54e-003
Isobutane	5.51e-005	2.67e-003
n-Butane	2.82e-004	1.37e-002
n-Hexane	1.26e-004	6.13e-003
Cyclohexane	2.63e-004	1.28e-002
Other Hexanes	1.60e-004	7.76e-003
Heptanes	5.68e-004	2.76e-002
Methylcyclohexane	1.41e-003	6.84e-002
Benzene	3.99e-003	1.93e-001
Toluene	1.64e-002	7.98e-001
Ethylbenzene	3.08e-003	1.49e-001
Xylenes	2.33e-002	1.13e+000

C8+ Heavies	1.97e-002	9.57e-001
Total Components	100.00	4.85e+003

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 2.84e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	7.65e+001	1.03e+002
Carbon Dioxide	5.20e+000	1.72e+001
Nitrogen	2.99e-001	6.26e-001
Methane	1.75e+001	2.11e+001
Ethane	1.16e-001	2.60e-001
Propane	4.82e-003	1.59e-002
Isobutane	9.15e-004	3.98e-003
n-Butane	4.21e-003	1.83e-002
n-Hexane	1.03e-003	6.66e-003
Cyclohexane	1.99e-003	1.25e-002
Other Hexanes	1.35e-003	8.68e-003
Heptanes	3.79e-003	2.85e-002
Methylcyclohexane	9.03e-003	6.64e-002
Benzene	3.14e-002	1.84e-001
Toluene	1.07e-001	7.35e-001
Ethylbenzene	1.68e-002	1.34e-001
Xylenes	1.24e-001	9.86e-001
C8+ Heavies	6.62e-002	8.45e-001
Total Components	100.00	1.45e+002

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	95 bbl Used Oil Sump Tank
City:	
State:	Colorado
Company:	
Type of Tank:	Horizontal Tank
Description:	Conservatively using Jet Kerosene for the 95 bbl (3,990 gal) Used Oil Sump Tank

Tank Dimensions

Shell Length (ft):	5.00
Diameter (ft):	12.00
Volume (gallons):	3,990.00
Turnovers:	4.00
Net Throughput(gal/yr):	15,960.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Denver, Colorado (Avg Atmospheric Pressure = 12.12 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

95 bbl Used Oil Sump Tank - Horizontal Tank
, Colorado

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Jet kerosene	All	60.36	47.87	72.86	53.29	0.0086	0.0056	0.0121	130.0000			162.00	Option 1: VP60 = .0085 VP70 = .011

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

95 bbl Used Oil Sump Tank - Horizontal Tank
, Colorado

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Jet kerosene	0.42	2.41	2.83

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	500 gal Lube Oil Tanks
City:	
State:	Colorado
Company:	
Type of Tank:	Horizontal Tank
Description:	Conservatively using Jet Kerosene for the 500 gal Lube Oil Tanks

Tank Dimensions

Shell Length (ft):		5.00
Diameter (ft):		4.00
Volume (gallons):		500.00
Turnovers:		12.00
Net Throughput(gal/yr):		6,000.00
Is Tank Heated (y/n):	N	
Is Tank Underground (y/n):	N	

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Denver, Colorado (Avg Atmospheric Pressure = 12.12 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

500 gal Lube Oil Tanks - Horizontal Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Jet kerosene	All	60.36	47.87	72.86	53.29	0.0086	0.0056	0.0121	130.0000			162.00	Option 1: VP60 = .0085 VP70 = .011

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

500 gal Lube Oil Tanks - Horizontal Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Jet kerosene	0.16	0.27	0.43

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	500 gal Ethylene Glycol (EG) Tank
City:	
State:	Colorado
Company:	BP America Production Company
Type of Tank:	Horizontal Tank
Description:	500 gal Ethylene Glycol (EG) Tank run is conservatively used for both the 500 gal and 300 gal tri-ethylene glycol (TEG) tanks

Tank Dimensions

Shell Length (ft):	5.00
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	12.00
Net Throughput(gal/yr):	6,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Denver, Colorado (Avg Atmospheric Pressure = 12.12 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

500 gal Ethylene Glycol (EG) Tank - Horizontal Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Ethlylene Glycol	All	60.36	47.87	72.86	53.29	0.0011	0.0006	0.0020	62.0700			62.07	Option 2: A=8.7945, B=2615.4, C=244.91

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

500 gal Ethylene Glycol (EG) Tank - Horizontal Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Ethlylene Glycol	0.01	0.02	0.03

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	75 gal Emulsion Breaker Tank
City:	near Durango
State:	Colorado
Company:	BP America Production Company
Type of Tank:	Horizontal Tank
Description:	Baker Petrolite WLC821 A-Sol P-38

Tank Dimensions

Shell Length (ft):	5.00
Diameter (ft):	3.00
Volume (gallons):	75.00
Turnovers:	12.00
Net Throughput(gal/yr):	900.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Denver, Colorado (Avg Atmospheric Pressure = 12.12 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

75 gal Emulsion Breaker Tank - Horizontal Tank
near Durango, Colorado

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Baker Petrolite WLC821 A-Sol P-38	All	60.36	47.87	72.86	53.29	2.1200	2.1200	2.1200	130.0000			130.00	Option 1: VP60 = 2.12 VP70 = 2.12

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

75 gal Emulsion Breaker Tank - Horizontal Tank
near Durango, Colorado

Annual Emission Calcaulations

Standing Losses (lb):	31.2946
Vapor Space Volume (cu ft):	22.5114
Vapor Density (lb/cu ft):	0.0494
Vapor Space Expansion Factor:	0.0901
Vented Vapor Saturation Factor:	0.8558
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	22.5114
Tank Diameter (ft):	3.0000
Effective Diameter (ft):	4.3713
Vapor Space Outage (ft):	1.5000
Tank Shell Length (ft):	5.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0494
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.1200
Daily Avg. Liquid Surface Temp. (deg. R):	520.0337
Daily Average Ambient Temp. (deg. F):	50.2125
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	512.9625
Tank Paint Solar Absorptance (Shell):	0.6800
Daily Total Solar Insulation Factor (Btu/sqft day):	1,568.5833
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0901
Daily Vapor Temperature Range (deg. R):	49.9838
Daily Vapor Pressure Range (psia):	0.0000
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.1200
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	2.1200
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	2.1200
Daily Avg. Liquid Surface Temp. (deg R):	520.0337
Daily Min. Liquid Surface Temp. (deg R):	507.5378
Daily Max. Liquid Surface Temp. (deg R):	532.5297
Daily Ambient Temp. Range (deg. R):	27.9417
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.8558
Vapor Pressure at Daily Average Liquid:	
Surface Temperature (psia):	2.1200
Vapor Space Outage (ft):	1.5000
Working Losses (lb):	5.9057
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.1200
Annual Net Throughput (gal/yr.):	900.0000
Annual Turnovers:	12.0000
Turnover Factor:	1.0000
Tank Diameter (ft):	3.0000
Working Loss Product Factor:	1.0000
Total Losses (lb):	37.2003

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

75 gal Emulsion Breaker Tank - Horizontal Tank
near Durango, Colorado

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Baker Petrolite WLC821 A-Sol P-38	5.91	31.29	37.20

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	500 gal Methanol Tank
City:	near Durango
State:	Colorado
Company:	BP America Production Company
Type of Tank:	Horizontal Tank
Description:	

Tank Dimensions

Shell Length (ft):	5.00
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	12.00
Net Throughput(gal/yr):	6,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Denver, Colorado (Avg Atmospheric Pressure = 12.12 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

500 gal Methanol Tank - Horizontal Tank
near Durango, Colorado

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Methyl alcohol	All	60.36	47.87	72.86	53.29	1.4587	0.9735	2.1375	32.0400			32.04	Option 2: A=7.897, B=1474.08, C=229.13

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

500 gal Methanol Tank - Horizontal Tank near Durango, Colorado

Annual Emission Calcaulations

Standing Losses (lb):	21.1538
Vapor Space Volume (cu ft):	40.0203
Vapor Density (lb/cu ft):	0.0084
Vapor Space Expansion Factor:	0.1996
Vented Vapor Saturation Factor:	0.8661
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	40.0203
Tank Diameter (ft):	4.0000
Effective Diameter (ft):	5.0475
Vapor Space Outage (ft):	2.0000
Tank Shell Length (ft):	5.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0084
Vapor Molecular Weight (lb/lb-mole):	32.0400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	1.4587
Daily Avg. Liquid Surface Temp. (deg. R):	520.0337
Daily Average Ambient Temp. (deg. F):	50.2125
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	512.9625
Tank Paint Solar Absorptance (Shell):	0.6800
Daily Total Solar Insulation Factor (Btu/sqft day):	1,568.5833
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.1996
Daily Vapor Temperature Range (deg. R):	49.9838
Daily Vapor Pressure Range (psia):	1.1640
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	1.4587
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.9735
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	2.1375
Daily Avg. Liquid Surface Temp. (deg R):	520.0337
Daily Min. Liquid Surface Temp. (deg R):	507.5378
Daily Max. Liquid Surface Temp. (deg R):	532.5297
Daily Ambient Temp. Range (deg. R):	27.9417
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.8661
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	1.4587
Vapor Space Outage (ft):	2.0000
Working Losses (lb):	6.6768
Vapor Molecular Weight (lb/lb-mole):	32.0400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	1.4587
Annual Net Throughput (gal/yr.):	6,000.0000
Annual Turnovers:	12.0000
Turnover Factor:	1.0000
Tank Diameter (ft):	4.0000
Working Loss Product Factor:	1.0000
Total Losses (lb):	27.8306

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

500 gal Methanol Tank - Horizontal Tank
near Durango, Colorado

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Methyl alcohol	6.68	21.15	27.83